



FUNK & WAGNALLS NEW ENCYCLO- PEDIA

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FINNISH LITERATURE

to GANGRENE

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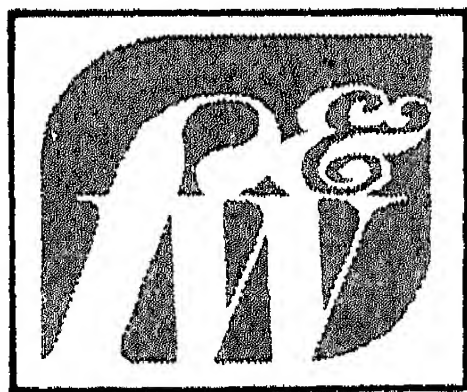
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NEW
ENCYCLO-
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LIST OF ABBREVIATIONS USED IN THE TEXT*

abbr.	abbreviated	fr.	from	OHG.	Old High German
AC; a-c	alternating current	Fr.	French	ON.	Old Norse
A.D.	<i>anno Domini</i> (Lat., in the year of the Lord)	ft.	foot	ONF.	Old Norman French
		g	gram	O.T.	Old Testament
alt.	altitude	Gael.	Gaelic	oz.	ounce
A.M.	<i>ante meridiem</i> (Lat., before noon)	gal.	gallon	P.M.	<i>post meridiem</i> (Lat., after noon)
AM	amplitude modulation	Ger.	German	Pol.	Polish
amu or	atomic mass unit	Gr.	Greek	pop.	population
AMU		Heb.	Hebrew	Port.	Portuguese
anc.	ancient	Hind.	Hindustani	prelim.	preliminary
Ar.	Arabic	h.p.	horsepower	pron.	pronounced
AS.	Anglo-Saxon	hr.	hour	q.v.	<i>quod vide</i> (Lat., which see)**
A.S.S.R.	Autonomous Soviet Socialist Republic	Hung.	Hungarian		
		Hz	hertz or cycles per second	r.	reigned
at.no.	atomic number	I.	Island	R.	River
at.wt.	atomic weight	i.e.	<i>id est</i> (Lat., that is)	rev.	revised; revision
b.	born	in.	inch	R.R.	railroad
bbl	barrel	Ind.	Indian	Rum.	Rumanian
B.C.	before Christ	Ir.	Irish	Russ.	Russian
bd.ft.	board feet	It.	Italian	Ry.	railway
bev or	billion electron	K.	Kelvin	S.	south; southern
BeV	volts	kg	kilogram	sec.	second
b.p.	boiling point	kHz	kilohertz	S.F.S.R.	Soviet Federated Socialist Republic
B.T.U.	British Thermal Unit	km	kilometer	Skr.	Sanskrit
bu.	bushel	kw	kilowatt	Sp.	Spanish
Bulg.	Bulgarian	kw hour	kilowatt hour	sp.gr.	specific gravity
C.	centigrade	lat.	latitude	sq.	square
cent.	century	Lat.	Latin	sq.mi.	square mile
Chin.	Chinese	lb.	pound	S.S.R.	Soviet Socialist Republic
cm	centimeter	long.	longitude	St.; Ste.	Saint
Co.	County	m	meter	Sum.	Sumerian
colloq.	colloquial	M.	Middle	Sw.	Swedish
cu.	cubic	mev or	million electron volts	temp.	temperature
Czech.	Czechoslovakian	MEV		trans.	translation
d.	died	mg	milligram	Turk.	Turkish
Dan.	Danish	MHz	megahertz	U.K.	United Kingdom
DC; d-c	direct current	mi.	mile	U.N.	United Nations
Du.	Dutch	min.	minute	U.S.	United States
E.	east; eastern	M.L.	Medieval Latin	U.S.A.	United States of America
ed.	edition; editor	mm	millimeter	U.S.S.R.	Union of Soviet Socialist Republics
Egypt.	Egyptian	mod.	modern		
Eng.	English	m.p.	melting point	var.	variant
est.	estimated	m.p.h.	miles per hour	vol.	volume
ev or	electron volt	Mt(s).	Mount, Mountain	vs.	versus or against
EV		N.	north; northern	W.	west; western
F.	Fahrenheit	Norw.	Norwegian	yd.	yard
fl.	flourished	N.T.	New Testament		
FM	frequency modulation	OE.	Old English		
		OF.	Old French		

*For a more extensive listing of abbreviations, widely used by authoritative sources in many fields, see ABBREVIATION. Charts of pertinent abbreviations also accompany the articles BIBLE, CANON OF THE; DEGREE, ACADEMIC; ELEMENTS, CHEMICAL; MATHEMATICAL SYMBOLS; and WEIGHTS AND MEASURES. Accent marks and special letters are explained in the article DIACRITIC MARK.

**The abbreviation (q.v.) stands for the Latin words "quod vide", meaning "which see". The placement of this abbreviation after a word—or a name or term—indicates that the word itself is the title of a separate article in the encyclopedia. By looking up the article on this word, or the entries on each word in a series that is followed by the plural form (qq.v.) of the abbreviation, the reader will find specific information about the words used as well as data about the main topic of the article he is reading.

FUNK & WAGNALLS NEW ENCYCLOPEDIA

FINNISH LITERATURE, works written by or traced to the people of Finland but, because of a continual affiliation with neighboring Sweden, not all necessarily in the Finnish language.

Origin and Early Swedish Influence. An extensive oral folk literature can be dated back to about 100 A.D. and the arrival into the area of the Finns (q.v.), a people of possibly Nordic and East-Baltic origin. Legends and myths, part of their pagan religion, served as the basis for much of their creative work. The most popular ancient forms included epic and lyric poetry, folksongs, fables, proverbs, and riddles.

In 1157 Finland was conquered by Sweden; see SWEDEN: *History*. Through the next six centuries, Swedish influence in administrative, religious, and educational areas increasingly altered the culture of the nation. Swedish was designated the official language, and with the introduction of Christianity, Latin, the language of the Church, came into similar wide usage. With most of the writing by the educated class being done in one or the other language, literature in the Finnish tongue remained sparse. The first book published in Finnish was the *ABC-Book* printed in 1563 by Bishop Michael Agricola (1506?-57). The bishop's subsequent translation of the New Testament, published in 1548, marked the earliest use of Finnish for religious writings. While the traditional oral forms continued to be transmitted, little other literature was produced in the Finnish language.

Nationalist Literary Movement. In 1809 Finland was ceded to Russia. Following the separation from Sweden, there emerged a Finnish nationalist movement, fanned to a large degree by historical research being done by the nation's academic community. The scholar Elias Lönnrot (1802-84), after many years collecting and studying the folksongs and sayings of ancient Finland, published the *Kalevala* in Finnish in 1835; he enlarged upon his compilation in 1849.

A subsequent awakening of pride in the Finnish language occurred among the nation's writers, inspiring them at last to produce in their native tongue.

By the mid-19th century, Finnish works were being published in all of the major literary forms. One of the most impressive monuments of Finnish prose is the novel *Seven Brothers* (1870) by Alexis Kivi (1834-72), a noted dramatist and comedy writer as well as a novelist. The book changed the emphasis of Finnish narrative literature by realistically, rather than romantically, portraying the rural folk. Early realism (q.v.) is also represented in the novels and stories of Juhani Aho (1861-1921) and in dramatic works by Minna Canth (1844-97). Of the comedies written since Kivi, the best is *Man's Rib* (1914), a depiction of marriage and divorce, by Maria Jotuni (1880-1943). Her last play, *Klaus, the Master of Louhikko*, was honored as the best Finnish drama of 1941. Naturalism (q.v.) in literature is represented in works by the novelists Joel Lehtonen (1881-1934), Ilmari Kianto (1874-1967), and 1939 Nobel Prize winner Frans Eemil Sillanpää (q.v.). The popular author Mika Waltari (1908-) is best known for his novel *The Egyptian* (1949). The greatest names in Finnish verse are the lyric master Eino Leino (1878-1926), the patriotic poet Veikko Antero Koskenniemi (1885-1962), the fiercely intensive Aaro Hellaakoski (1893-1952), the singer of suffering and death, Uuno Kailas (1901-33), the sensitive lyricist Kaarlo Sarkia (1902-45), and the poet of the Russo-Finnish War Yrjö Jylhä (1903-56).

After World War II, the Finnish literary scene flourished. The most prominent contemporary novelist is Väinö Linna (1920-) whose *The Unknown Soldier* (1954) became a best seller and was translated into several foreign languages. In his trilogy *Under the North Star* (1959-62), Linna forcefully describes the Finnish civil war in 1917. Promising although controversial novelists are

FINNISH MUSIC

Veijo Meri (1928–) and Paavo Rintala (1930–). Among the young modernists in poetry are Tuomas Anhava (1927–), Pentti Holappa (1927–), Eeva-Liisa Manner (1921–), Lassi Nummi (1928–), and Pentti Saarikoski (1937–).

Modern Works in Swedish. Many contemporary writers have chosen to publish in Swedish, thus finding a wide audience at home and an extended readership in neighboring Sweden. Among the figures of Finland's Swedish literature were Johan Ludvig Runeberg (1804–77), whose poem "Vårt Land" (1848; Eng. trans., "Our Land, Our Land") is the national hymn of Finland, and Zachris Topelius (1818–98), who is revered as a writer of fairy tales and historical novels. The most important of the 20th-century lyric poets are Edith Södergran (1892–1923), pioneer of modernism; Arvid Mörne (1876–1946), champion of the Swedish-speaking minority's cause; Bertel Gripenberg (1878–1947), a master of form; and Elmer Diktonius (1896–), a leading modernist. P.V.V.

FINNISH MUSIC. See FINLAND: *Music*; MUSIC: *History: The Romantic Era*.

FINN MAC COOL. See IRISH LITERATURE: *Irish Literature in Gaelic: Middle Irish Period: Fenian Cycle*.

FINNO-UGRIC LANGUAGES, subfamily of the Uralic languages spoken in parts of northern Scandinavia, eastern Europe, and northwestern Asia; see also, URAL-ALTAIC LANGUAGES; URALIC. It is one of two such subfamilies, the other being the Samoyed languages spoken in northwestern Siberia; see SAMOYEDS. The Finno-Ugric subfamily is usually divided into two large branches; Finnic, also called Finno-Permian, and Ugric. Finnic contains two major languages, Finnish, spoken in Finland by about 4,000,000 Finns (q.v.), and Estonian, spoken by 1,500,000 persons in Estonia (q.v.). Ugric contains the Hungarian language (q.v.) spoken by about 18,000,000 persons in Hungary and areas of Rumania. The Finnic branch also includes the following comparatively minor languages of the Soviet Union: Karelian a close relative of Finnish, spoken in the Karelian A.S.S.R.; Livonian, now virtually extinct; Veps, spoken around Lake Onega; Chereemis and Mordvin, languages spoken in the middle Volga R. region (the former by some 500,000 persons and the latter by about 1,500,000 persons); and Votyak and Zyrian, spoken by small, widely scattered groups in a vast area extending over the northeastern European part of the Soviet Union. (Votyak and Zyrian are sometimes considered separately as the Permiak or Permian subdivision of the Finno-Ugric languages.)

About fifteen languages spoken by nearly 30,000 Lapps, spread thinly over the northern European region known as Lapland (q.v.), are also classed as Finnic languages. The Ugric branch contains (besides Hungarian) two minor languages, Ostyak and Vogul; these are spoken by some 25,000 persons in the Ob R. valley of northwestern Siberia.

Frequently mentioned characteristic features of Finno-Ugric are vocalic or vowel harmony and consonant gradation, that is, alternation between two kinds of stem consonants. The linguistic type is agglutinative; see PHILOLOGY. Attempts to connect the Finno-Ugric subfamily with other language families, notably the Turkic branch of Altaic and the Indo-European languages (q.v.), have produced evidence of similarities, but not enough to prove any connection conclusively. Early Finno-Ugric, the reconstructed ancient parent language, was enriched through contact with Iranian (q.v.). In later times, the Finnic languages added words from the German and Slavic (particularly Russian) languages. Hungarian was influenced by German, Iranian, Italian, Latin, Slavic, and Turkish. **FINNS** (fr. Sw. *finne*), name applied to the inhabitants of Finland (q.v.), who call their land *Suomi* (Fin., "Finland") and themselves *Suomi* or *suomalaiset* (Fin., "inhabitants of Finland"). While the origin of the Finns has long been something of a mystery, scholars now generally agree that they migrated originally from the region between the Volga R. bend and the Ural Mts., lived for centuries in the Baltic area, then gradually moved to the area now comprising Finland about 2000 years ago. Racially the Finns are of East Baltic and Nordic stock; see RACES OF MANKIND. Finnish, their language, is one of the Finno-Ugric languages (q.v.). P.V.V.

FINSEN, Niels Ryberg (1860–1904), Danish physician, born in Tórshavn, and educated at the University of Copenhagen. He demonstrated that the effects of light upon biological processes are due almost exclusively to the violet and ultraviolet rays of the spectrum (q.v.); see ULTRAVIOLET RADIATION. The Finsen light, an early form of ultraviolet-ray lamp, was used successfully in the treatment of numerous skin diseases. In 1903 Finsen was awarded the Nobel Prize in medicine and physiology. He wrote *Chemical Rays and Variola* (1899) and *Phototherapy* (1901).

FINSTERAARHORN, peak in Switzerland, the highest of the Bernese Alps, rising to a height of 14,022 ft. above sea level. It was first scaled in 1812.

FIORD. See FJORD.

FIR, common name for any tree of the genus *Abies*, belonging to the Pine (q.v.) family Pinaceae. The trees, known as true firs, generally have a straight trunk with somewhat pyramidal growth. The branches grow in whorls from the trunk. The cones, which are erect at maturity, are composed of thin, close scales. Each scale bears two winged seeds. The flat leaves are scattered, with the midribs showing clearly on the whitish undersurfaces.

About twenty-five species of true firs are widely scattered throughout the Northern Hemisphere. The silver fir of Europe, *A. alba*, sometimes reaches a height of 150 ft., with large boughs curved upward at their outer extremities. The leaves are dark green above, with two white lines beneath. When seen from below the tree appears to have a silvery color. This tree is abundant in the mountains of southern and central Europe, but does not occur in northern Europe. It is also found in Asia, in the Caucasus mountains.

Ten species of fir are native to North America, growing chiefly in the region west of the Rocky Mts. They achieve maximum growth in the Sierra Nevada and Cascade mountain ranges. The balsam fir, *A. balsamea*, is found from Vir-



Right: Balsam fir, *Abies balsamea*. Below: Balsam cones, bearing seed, at maturity. U.S. Forest Service



ginia to Newfoundland and northwestward to the Yukon and Labrador. It grows from 40 to 60 ft. high, and its leaves are highly fragrant and resinous. The balsam fir, probably the best known of the true firs, is used for pulpwood, and yields the oleoresin known as Canada balsam (q.v.). The noble fir, *A. procera*, found in California, Washington, and Oregon, grows to a height of 100 to 200 ft., with a trunk as large as 8 ft. in diameter. The alpine fir, *A. lasiocarpa*, is smaller than the noble fir, growing commonly from 80 to 100 ft. high. It is found from New Mexico to Alaska in the Rocky Mts. The lowland or grand fir, *A. grandis*, growing from Montana to the Pacific coast, occasionally reaches a height of 300 ft.

True firs do not have the resin ducts which typify true pines or spruce, although these trees all resemble one another in softness of wood. The erroneously named Douglas fir (q.v.), *Pseudotsuga taxifolia*, a large tree of the western United States, is not a true fir.

FIRDAUSI or **FIRDUSI** or **FIRDOUSI**, real name ABDUL QASIM MANSUR (about 940–about 1020), Persian poet, born near Tun in Khursan. He has been called the “Homer of Persia”. Little is known of his early life. He belonged to the landed gentry, was married at the age of twenty-eight, and some eight years later began the work for which he is most famous, the great epic poem *Shāh-Namāh*, or *Book of Kings*. The work is based on a poem by the 10th-century Persian poet Dakiki. Firdausi spent thirty-five years writing this epic and completed it in 1010, when he was about seventy years old.

The poem contains 60,000 rhyming couplets, making it more than seven times the length of the *Iliad* (q.v.) by Homer, the ancient Greek poet. It deals first with the legendary Persian kings: Gayumart, Hoshang, Tahmuras, and the most famous of the group, Jamshid, who reigned for 500 years during the golden age of the earth. Following this happy period came the evil rule of the Arab Dahhāk, or Zohak, who was tempted by Ahriman, his own ancestor. As a result, Dahhāk fell into sin, becoming more and more evil until the smith Kavah rebelled and set up his leathern apron as the banner of revolt. Finally, Fredun, the Thraetaona referred to in the Avesta (q.v.), came and bound the tyrant and confined him beneath Mount Demavend on the shores of the Caspian Sea. Soon after this point in the poem there is inserted an episode of considerable beauty which recounts the loves of Zal, of the royal line of Persia, and Rudabah, the daughter of the king of Kabul. Their union resulted in the birth of the most romantic of all

the heroes of the *Shāh-Namāh*, Rostam, who occupies a position in Iranian legend somewhat analogous to that of Hercules in Classical literature. The epic progresses through Persian legend to history, tracing the reigns of the Sassanian kings down to the Muslim conquest and the death of Yazdegird III in 641. Thus the work constitutes a valuable source for the early history of Persia, which is needed to supplement the accounts given in the old Persian cuneiform inscriptions and the Avesta. In addition to his poetic incentive, Firdausi had a distinctly patriotic motive in writing the *Shāh-Namāh*. He plainly desired to keep alive in the hearts of his people the faith of their ancestors and the glories of their deeds so that the Persians would not become mere puppets under Arabian domination.

The epic contains an introductory eulogy of Sultan Mahmud of Ghazni (fl. 10th cent.), to whom the work is dedicated. Firdausi went to Mahmud's court to present his work as a tribute and was awarded the sum of 20,000 dihrms, or about \$2400. The amount was less than he had been led to expect. The disappointed poet took his revenge by writing a bitter satire on Mahmud, which he sent to the sultan as a substitute for his former eulogy. Firdausi then fled to Herat, and then to Tabaristan, where the reigning prince protected him. He later settled in Baghdad where he composed an epic of 9000 couplets, *Yūsuf and Zuleikha*. The work is an Arabic version of the Biblical story of Joseph and Potiphar's wife, a favorite theme of Oriental poets. In his old age Firdausi retired to his native town near Tun, where, according to legend, he received Mahmud's forgiveness just before his death. The *Shāh-Namāh* is perhaps best known to English readers through *Sohrab and Rustum*, a poem by the English poet Matthew Arnold (q.v.), which has the Persian epic for its source.

FIRE, heat and light resulting from the rapid combination of oxygen with other materials. The light is in the form of flame, which is composed of (1) glowing particles of the burning material; and (2) certain gaseous products that are luminous at the temperature of the burning material. The conditions necessary for the existence of fire are (1) presence of a combustible substance; (2) temperature (called the kindling temperature) high enough to cause combustion; and (3) presence of enough oxygen (usually provided by the air) to enable rapid combustion to continue. See COMBUSTION; FLAME.

Methods of Making Fire. Fire has been produced by two principal methods: friction and percussion. The object of friction is to raise to

kindling temperature the area within a pile of combustible material (kindling). The percussion method produces a spark to set kindling afire.

Primitive peoples have used and still use chiefly the friction method, in which two pieces of wood surrounded by combustible material are rubbed together until the kindling temperature is reached. In the stick-and-groove method, a stick is rubbed in a groove in another piece of wood. In the fire-drill method, a stick is rotated rapidly in a pit in a stationary piece of wood. The stick is rotated by rubbing between the palms of the operator or by a sawing motion of a wooden bow whose string is wrapped around the stick.

The most primitive percussion method of producing fire is striking together two pieces of flint, or flint and iron pyrites. Later, steel was substituted for the iron pyrites. The flint-and-steel method prevailed throughout the civilized world until about 1827, when matches (q.v.), a friction method, came into use. The principle of percussion is used in most cigarette lighters.

Fire may be also produced by using a lens or curved reflector to concentrate the rays of the sun upon combustible material. See FURNACE: *Solar Furnace*.

The development of man's use of fire probably had four stages. First, man observed about him natural sources of fire, such as volcanoes and trees set afire by lightning. Second, he acquired fire from natural sources and used it for warmth, light, and protection from wild beasts. Third, he learned to make fire whenever he chose. Finally, he learned to control fire for use in smelting metal ore, baking pottery, and numerous other ways to make life more comfortable and pleasant.

The keeping and use of fire probably had an influence in ending nomadism and consequently in the development of the social and political institutions connected with a fixed abode. See also FIRE WORSHIP.

FIRE ALARM. See FIRE FIGHTING.

FIRE ANT. See ANT: *Ant Pests*.

FIREARM. See RIFLE; SMALL ARMS.

FIRE ASSAYING. See ASSAYING.

FIREBALL. See METEOR.

FIRE BLIGHT. See DISEASES OF PLANTS.

FIRE DAMP. See COAL: *Mine Labor and Safety*; METHANE.

FIRE DEPARTMENT, organization developed to prevent fires and to extinguish them. The fire department may be part of a municipal or county government or of an independent fire district, or it may be a voluntary nonprofit association.



Modern urban fire departments use such specialized equipment as the aerial ladder, which may be extended to about 110 ft. Powered by the fire engine motor, the ladder enables firemen to direct a stream of water at fires on high floors and to evacuate burning buildings.

United States Rubber Co.

Development. In 1648 Peter Stuyvesant (q.v.), director-general of New Netherlands, appointed four fire-masters whose responsibility was to inspect buildings and enforce fire-prevention measures. The fire-masters made sure that buildings had clean chimneys and that there was an adequate supply of fire ladders and buckets available for fighting fires. The actual fire fighters were citizens, all of whom were required to maintain fire buckets, long swabs for putting out roof fires, and fire ladders; they fought under the direction of fire wardens.

Boston, Mass., established the first paid fire department in 1678. It had thirteen men and a hand-operated fire engine, or pumper. By 1715 Boston had six pumpers. Leading citizens of the city also formed voluntary fire societies to remove members' property endangered by fire. Volunteer engine companies Nos. 1 and 2 were organized in New York City in 1731 to man fire engines imported from Great Britain. The New

FIRE DEPARTMENT

York City fire department remained a volunteer organization until 1865. In 1736 Benjamin Franklin (q.v.) founded the first volunteer fire department in Philadelphia, Pa., the Union Fire Company, which existed until 1820. Not until the middle of the 19th century did the modern fire department with paid personnel and standardized equipment become an integral part of municipal administrations.

Organization. The organization of a fire department varies with the structure of the municipal government. In some cities the mayor appoints a fire commissioner to administer the department; other cities have a board of fire commissioners with a fire chief as executive officer and head of the uniformed force; while in still other cities a safety director may be in charge of both police and fire departments. In the great majority of cities, however, the fire department is headed by a chief, or a chief engineer, many of whom are appointed on the basis of competitive civil-service examinations. See CIVIL SERVICE.

A chief officer must be on duty at all times. This object is usually accomplished in a paid fire department by having a deputy or assistant chief on each duty shift, and in volunteer fire departments by appointing sufficient assistant chiefs. Also, there is always at least one chief on duty for every eight fire companies. Where a fire department has more than eight companies, the companies are organized into battalions or districts, with a chief in charge of each. In still larger departments, fire battalions or districts may be organized into divisions, again with a chief in charge of each.

In addition to the line companies, which actually perform the fire-fighting function, large fire departments are divided into various staff divisions or bureaus, such as fire prevention, training, maintenance, fire alarm and communications, and administration, with a chief in charge of each. The bureaus may in turn be divided into divisions or sections, with a chief officer or captain in charge. The titles in the chain of command vary from one city to another but grades of command can be distinguished locally by the number of crossed trumpets, or "bugles", on the officer's insignia, five crossed trumpets being the maximum.

The basic operating unit of the fire department is the company, commanded by a captain. A captain may be on duty on each shift, although in some fire departments lieutenants and sergeants command companies when the captain is off duty. Fire companies are usually organized to man certain types of fire apparatus.

There are, for example, engine companies, ladder companies, and squad or rescue companies.

In smaller communities, a single fire company may be organized to man all of the different equipment assigned to one fire station. Off-duty firemen are recalled to duty when needed and then paid overtime rates. This provision is less expensive for a small community than having full work shifts continually on duty.

Firemen undergo continuous training, beginning with the probationary firemen's training school. Training continues throughout a fireman's career and it is not unusual for a chief officer to have undergone over 8000 hours of systematic training and instruction. The average paid fireman undergoes between 200 and 300 hours of training per year, not including specialized courses; volunteer firemen average 50 to 100 hours of training per year.

Foreign Fire Departments. Despite some differences in detail and terminology, fire departments in most of the technically advanced countries of the world are very similar to those in North America.

Following World War II the smaller local fire departments in Great Britain (called "fire brigades") were consolidated into county and county borough departments. These larger organizations are better able to maintain adequate professional staffs than could the former small departments. There is a well-developed fire college at Gravenhurst Dorking, Surrey, and a training center at Moreton-in-Marsh, Gloucestershire, that are considered models throughout the world. The same general types of fire-fighting apparatus and equipment are used in Great Britain as in North America. The aerial ladder is called a turntable ladder and a nozzle is termed a branch pipe.

In Paris, France, the fire department is operated by a regiment of the French army; the Marseilles fire department is operated by the French navy.

Both the paid and volunteer fire departments of West Germany are among the most efficient in the world. Most of the chief officers of the paid fire departments have engineering degrees. Germany has long been noted for the excellence of its fire-fighting equipment.

The Tokyo, Japan, fire department is one of the largest, best organized, and most efficient in the world. Until the end of World War II the fire department had been a somewhat neglected minor bureau of the police department, but after the war, with the assistance of American fire service advisers, it was reorganized into a separate fire department. W.Y.K.

FIRE ENGINE, popular name for the basic unit of motorized fire apparatus, referred to by firemen as an engine or pumper.

The first fire engines were hand-drawn and hand-operated pumps called tubs. A tub was filled by bucket brigades consisting of lines of citizens passing buckets between a town pump or cistern and the tub. It was many years before pumps with suction hose were introduced. The suction hose could then be placed in the water supply and the water discharged under pressure into a fire hose. In many cases, to reach the fire, water had to be pumped from one engine to another; an engine that overflowed because it could not discharge fast enough the water being received was retired from service.

Steam Fire Engines. In 1851 Cincinnati, Ohio, purchased the first steam-operated fire engine intended for use by a regular fire department. The next year a paid fire department was organized in Cincinnati to man the steam engine, replacing unpaid volunteers. Cities had tried since 1840 to use steam engines but these attempts had led to riots by the volunteer fire fighters. Rioting by volunteers in Cincinnati led to the disbanding of volunteer companies.

By the end of the American Civil War, paid fire departments equipped with steam pumps were in service in most large cities. In some cities the steam pumps towed hose reels and in other cities separate horse-drawn reels were used. Steam pumps came in various sizes. Most were equipped with reciprocating piston pumps, although a few rotary pumps were used. The early steam engines had a capacity of 500 gal. per min. (g.p.m.) at a pressure of 100 lb. per sq.in. (p.s.i.). Toward the end of the 19th century, large steam engines having capacities of 900 and 1100 g.p.m. at discharge pressures of 100 p.s.i. were built.

Motorized Fire Engines. The first motorized pumps were introduced about 1903. By the end of World War I, steam pumps that were still in service were drawn by motorized tractors. By 1925 motorized pumps had replaced steam pumps almost completely.

Practically all modern pumps are equipped with centrifugal fire pumps. These pumps can supply water in a large range of volumes and pressures. When connected to hydrants furnishing an adequate supply of water, the pumps can frequently pump water at pressures and volumes considerably in excess of their rated capacity at draft.

The pumps are tested by the Underwriters' Laboratories, Inc., a laboratory established by fire insurance companies to test equipment,

and must be able to deliver their rated capacity at 150 p.s.i. net pressure while drafting, 70 percent of their rated capacity at 200 p.s.i., and 50 percent of rated capacity at 250 p.s.i. A discharge capacity of 250 g.p.m. is considered a standard hose stream. Pumps are rated according to the number of 250-g.p.m. streams of water they can supply at a pump pressure of 150 p.s.i. Pumps used in rural communities usually have a capacity of 750 g.p.m. and pumps used in cities usually have a capacity of 1000 g.p.m. or more. That is, a rural pumper has a three-stream capacity and a city pumper has at least a four-stream capacity.

Pumps carry several thousand feet of fire hose. The most frequently used sizes are 1½ in. and 2½ in. in diameter, although many pumps carry larger diameter hoses where heavier flows are required. Short lengths of large hose are also carried for attachment to hydrants. Pumps used in rural communities carry hard suction hose for drawing water from distant sources.

Fire engines also have built-in water tanks that supply water for the initial attack on a fire while firemen connect the pump to hydrants. The smallest size tank in use has a capacity of 300 gal., and the largest is about 800 gal. Above 800 gal. the fire engine is classified as a tanker although it has a pump.

Pumps carry a basic selection of almost every type of equipment used for fighting a fire, ventilating a building, rescue, and salvage operations. Extension ladders up to 35 ft. in length are carried, plus a variety of nozzles and nozzle tips in different sizes for every kind of hose carried by the pumper. The nozzles include both straight stream and spray types.

The pumper has one or more fixed monitor, or turret, nozzles capable of discharging 500 to 1000 g.p.m. at pressures of 80 to 100 p.s.i. In addition, the pumper supplies water under pressure for large-capacity ladder pipes, for turret nozzles on elevating platforms, and for tower ladders.

The New York City fire department has a super-pumper capable of supplying up to 8000 g.p.m. at high pressures. The super-pumper is accompanied by a fleet of special trucks carrying large nozzles and 4-in. high-pressure hose. Other cities, including Baltimore, Md., Boston, Mass., Rochester, N.Y., and Toronto, Canada, have maintained high-pressure water systems. In these cities, when an alarm is received, pumping stations immediately bring the water pressure in the mains up to 150 p.s.i. The pumping stations can supply 12,000 g.p.m.

Many large cities that lack a high-pressure

FIRE EXTINGUISHER

water system are using pumpers capable of supplying 1250 to 2000 g.p.m. The Los Angeles, Calif., fire department has equipped many of its engine companies with two large-capacity pumpers; in addition, Los Angeles has several pumpers in service with capacities between 2000 and 3000 g.p.m. Los Angeles also has large manifold trucks carrying 3½-in. hose and equipped with batteries of large nozzles. When connected to high-capacity pumpers, the manifold truck can discharge up to 4500 g.p.m.

The Memphis, Tenn., fire department also has large-capacity pumpers and, in addition, a multi-master truck that can discharge 3000 g.p.m. through a large, hydraulically controlled nozzle. The truck also has several other large-capacity hose outlets and large foam nozzles. The truck is supplied with water through twelve 3-in. hose connections.

Ladder Trucks. The ladder truck is a large vehicle that carries a power-operated aerial ladder and a larger assortment of tools and equipment than a pumper does, including several extension ladders. A few combination pumper-ladder trucks have been built but they are considered less satisfactory than separate vehicles for fighting fires.

Fireboats. Fireboats are built in sizes ranging from small, high-speed, jet-propelled rescue craft to large fire tugs. Pumping capacity, at a pressure of 150 p.s.i., ranges from 1000 to 20,000 g.p.m., depending on the size and capacity of the pumping equipment. Fireboats carry substantially all the fire-fighting equipment found on land apparatus as well as special equipment necessary for marine fire fighting and water rescues. *See also* FIRE FIGHTING.

W.Y.K.

FIRE EXTINGUISHER, portable device used to put out fires, which are grouped in three classes. Class A fires include those in which ordinary combustibles such as wood and paper are burning. Class B fires are those in which flammable liquids are burning. Class C fires are those involving electrical equipment. Each class of fire requires a particular type of fire extinguisher.

Standards for portable fire extinguishers are issued by the National Fire Protection Association, a non-profit technical and educational organization of Boston, Mass. The standards include all types and sizes of extinguishers that are listed and approved by the Underwriters' Laboratories, Inc., Underwriters Laboratories of Canada, and the Factory Mutual Laboratories, laboratories established by fire insurance companies to test equipment. Extinguishers are tested against standard test fires of the types

they are designed to control. Each extinguisher is then rated as to both type and size of the fire extinguished. For example, a 10-B extinguisher will put out a fire in flammable liquids that is ten times the size of fire that a 1-B extinguisher can extinguish. Extinguishers that cannot extinguish the minimum size test fires are not listed and rated.

Fire extinguishers require periodic servicing and recharging. Fire department inspectors check at periodic intervals that fire extinguishers are provided in buildings where required by law or by insurance organizations and that they have been serviced within the specified time period.

Extinguishers for Class A Fires. Class A fire extinguishers are usually water-based. A very common type of extinguisher consists of a pump tank operated by a small hand pump incorporated into the tank. This extinguisher is simple to use and recharge. Other types of water-based extinguishers use air under pressure to expel the water. In other designs, a gas cartridge expels the water.

Extinguishers for Class B Fires. Three principal types of extinguishing agents, carbon-dioxide gas, dry chemical (usually bicarbonate of soda treated to prevent caking), and foam, are used for fires involving flammable liquids, greases, and oils. Fire departments prefer the dry chemical because it does not blow away out of doors and it inhibits flashback, the return of flame in an undesirable location, in cases in which the temperature of the fuel has not been lowered below its flashpoint. Carbon dioxide is a good smothering agent but has little cooling capacity. Foam is also a good smothering agent but it does not extinguish fires as rapidly as other types of class B agents and it also leaves a greater mess afterward.

Vaporizing liquid extinguishers employing halogenated extinguishing agents, such as carbon tetrachloride, were once widely used but are now seldom employed because of the corrosive and toxic effects of the chemicals and because of Federal and State health restrictions regarding their use.

Extinguishers for Class C Fires. Both carbon dioxide and dry chemicals can be used in electrical fires. An advantage of carbon dioxide is that it leaves no residue to be cleaned up after the fire is extinguished. Special water spray nozzles are also available for class C fires.

Foam must not be used on electrical fires because it is a conductor of electricity. In any case, the electricity should be disconnected or the circuit grounded before the fire is extinguished.



Fire fighters must remain at a safe distance when using extinguishers on live electrical equipment.

The Underwriters' Laboratories, Inc. has available lists of approved fire extinguishers that may be purchased from different manufacturers. The extinguisher label gives operating instructions and identifies the class, or classes, of fire on which the extinguisher may be used safely. Approved extinguishers also carry the labels of the laboratories at which they were tested. W.Y.K. **FIRE FIGHTING**, techniques and equipment used to extinguish fires and limit the damage caused by fires. About forty percent of the accidental fires in the United States are caused by careless smokers or by negligent use of electrical equipment. Fires result in more than 12,000 deaths annually and destroy several billion dollars worth of public and private property, including forest land.

The basic elements in fires are fuel (combustible materials) and oxygen. Remove one of these elements and the fire cannot sustain itself. Fundamentally, fire fighting consists of removing or reducing one or more of these elements to as large a degree as possible.

Different kinds of fuels have different ignition temperatures. The ignition temperature of a combustible solid is influenced by the rate of air flow, the rate of heating, and the size of the

Fireboats, pumping water directly from the body on which they float, can move close to the scene of harbor fires.

New York Fire Dept.

solid. Most fire fighting consists primarily of putting water on the fire, thus cooling the burning material to the point at which combustion is no longer self-sustaining. Fire involving flammable liquids, certain chemicals, and combustible metals may require special extinguishing agents and techniques. Indeed, with some fuels the use of water may be dangerous.

Early History of Fire Fighting. In colonial America, night watchmen patrolled the streets or watched for signs of fire from watchtowers. The alarm was spread by the watchman's rattle and the ringing of church bells, and citizens responded to the alarm, carrying buckets.

To stop the fire, the fire fighters frequently attempted to remove the fuel. A large hook was attached to a rope, the hook was thrown over the roof of the burning building, and the fire fighters pulled the building down, thereby creating a firebreak that prevented the spread of the fire.

The first fire engines used in the United States were imported from Great Britain. They had fixed nozzles attached to the engine, requiring the engine to be placed close to the fire. The technique of fighting fires advanced at the beginning of the 19th century with the develop-

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ment of hose capable of withstanding relatively high pressures without springing leaks. Hand-stitched leather hose was used at first, but it was soon replaced by copper-riveted hose. Fifty-foot lengths of copper-riveted leather hose coupled together with brass fittings enabled the fire fighters to convey water through narrow passages, up stairways, and into buildings, while the pumps were operated in the street. Cotton-covered rubber hose was developed around 1870. See FIRE ENGINE.

The first fully paid fire department using steam engines was organized in Cincinnati, Ohio, in 1852. By the end of the American Civil War, volunteer, or call, firemen had been replaced by paid forces in the major cities. See FIRE DEPARTMENT.

The first high-pressure water system, consisting of a separate system of water mains and hydrants used solely for fire fighting, was established in Rochester, N.Y., in 1874. The aerial ladder was introduced about 1874, and the water tower for elevated streams of water was introduced soon after. Steam-operated pumps gradually replaced hand-operated equipment and, during the first quarter of the 20th century, motorized engines and other apparatus replaced the fire horse.

Water Supplies. The availability of water is always a prime concern of firefighters. In metropolitan areas, water is usually taken from a municipal or metropolitan supply system.

Rural areas, where buildings are widely separated, often lack public water mains or fire hydrants. The local fire department must therefore carry their water with them. Rural fire engines usually have a 500-gal. water tank. This is supplemented by mobile tank trucks with a capacity between 1000 and 4500 gal. The tanks may be refilled by pumping water from wells, cisterns, streams, ponds, or private water systems. Portable pumps are carried to the source of water if it cannot be reached by motorized fire trucks.

Motorized Apparatus and Ancillary Equipment. The basic piece of fire-fighting apparatus is the fire engine (q.v.) or pumper. For most building fires, however, additional apparatus is required. Hose-tender trucks carry additional quantities of hose and heavy nozzle equipment. Ladder trucks have hydraulically operated ladders that can be extended as much as 100 ft. Ladder trucks also carry an extensive assortment of equipment, both for fighting fires and for rescue work. Elevated platform trucks, or "snorkels", can raise firemen and nozzles as high as 90 ft., enabling the firemen to gain entry into buildings, perform rescues, and direct streams

of water into burning buildings. Rescue or squad trucks carry a wide assortment of rescue and emergency equipment, including resuscitators, self-contained breathing apparatus, and forcible entry tools. Salvage trucks carry implements for reducing water damage, including large waterproof covers, dewatering devices, and tongs for shutting off automatic sprinkler heads.

Fire Alarms. A fire alarm telegraph system with street call boxes was introduced in Boston, Mass., in 1852. Today, many communities are served either with the telegraph alarm system or with telephone call boxes. Most fire alarms, however, are sounded by people calling the fire department from private telephones. The alarms are then transmitted to the fire stations by radio or over special alarm circuits. In large cities and in many counties, alarms are received at a central dispatch office and then transmitted to the fire stations. Apparatus is dispatched according to the nature of the alarm and the location of the fire. Typically, on a first alarm more apparatus is sent to industrial sections, schools, institutions, theaters, and other places where there may be a great hazard to life, than to neighborhoods consisting of single-family dwellings.

Fires that cannot be brought under control by the apparatus responding to the first alarm are multiple-alarm fires. Each additional alarm brings more manpower and apparatus to the scene. Special calls are sent for specific types of equipment.

All fire apparatus, including the cars of chief officers, is equipped with two-way radios and is under the control of the fire alarm dispatchers. This procedure allows personnel to be engaged in fire prevention, training, or other duties and still remain available for emergency calls. In addition, apparatus can be dispatched from one fire to another without having to return to its station.

No single fire department is large enough to cope with every possible fire situation or a number of simultaneous major fires. Accordingly, mutual aid plans are in effect among adjacent fire departments for assisting each other both in fighting fires and in covering vacated fire stations. In many cases a number of local fire departments are dispatched from a central county or metropolitan communications center. In a number of States, statewide fire mobilization plans are in effect for use in major emergencies.

At the Fire. Bystanders frequently do not understand the complexity of fire-fighting operations at a fire that seriously threatens life and

property. Highly developed tactical operations are carried out by fire companies under the direction of chief officers.

The basic tactics of fighting a fire can be divided into the following categories: rescue operations, protection of buildings exposed to the fire, confinement of the fire, extinguishing the fire, and overhaul of the fire area. The officer in charge, the fireground commander, estimates the relative importance of these categories, taking into account the need for ventilating the burning building (discussed below) and salvaging what can be saved. He also estimates what additional assistance or apparatus he may need. Rescue operations are always given priority, but sometimes rescues can be performed only in conjunction with the fire-fighting effort.

Once the fireground commander has judged the situation, he must deploy his forces in the most advantageous manner. Pumper, ladder, and other truck companies, as well as rescue squads, are assigned to different areas of the fire, usually in accordance with the number and types of hose streams the fireground commander considers necessary to control the fire and prevent its spread.

Usually, responses to first alarms are planned in advance, and the fire companies go immediately to their assigned locations without waiting for specific orders. In addition, fire departments have contingency plans for fighting fires covering large areas, large buildings, or particularly hazardous locations. Commonly, on a first alarm, one of the pumpers attacks the fire as quickly as possible, using preconnected hose lines supplied by the water tank in the truck, while heavier hose lines are being attached to the hydrants. Members of the ladder and squad companies force their way into the building, search for possible victims, ventilate the structure, and perform salvage operations.

A principal concern of the fireground commander is the water supply. Where the available water supply is smaller than the situation demands, the chief must use this water as efficiently as possible while using other pumpers to relay additional water from more distant hydrants or nearby bodies of water. In some cases he must rely on teams of water tankers.

A blaze feeding on combustibles in the interior of a building can generate tremendous heat. Sometimes temperatures exceed 1500° F. While a brightly burning fire generates heat principally, a smoldering fire produces both heat and combustible gases, which need only additional oxygen to burn with explosive force. The hazards to which firemen and the occupants of a

burning building are exposed include the breathing of superheated air, toxic smoke and gases, and oxygen-deficient air. Other dangers are burns and injuries suffered during attempts to escape by jumping or falling, or because of broken glass, falling objects, or collapsing structures.

Handling a hose is a difficult matter even before the line is charged with water under pressure. Nozzle reaction forces can amount to several hundred pounds, requiring the efforts of several men to direct a stream of water.

Ventilation. The general attack on structural fires requires truckmen of the ladder company to open up the building to allow the heat and smoke to escape while the enginemen prepare to extinguish the fire. This explains the vigor with which windows are opened or broken and holes cut in the roof. The prompt opening of a building can prevent thousands of dollars of heat and smoke damage and possibly avert the loss of the entire structure. Fire trucks carry power-operated smoke ejection fans capable of removing 5000 to 10,000 cubic feet of smoke or gas per minute.

Types of Nozzles. Various nozzles are capable of projecting solid, heavy streams of water, curtains of spray, or fog. Fire trucks carry a selection of nozzles, which are used according to the amount of heat that must be absorbed. Nozzles can apply water in the form of streams, spray, or fog at rates of flow between 15 gal. to more than 1000 gal. per min. Straight streams of water have greater reach and penetration, but fog absorbs heat more quickly because the water droplets present a greater surface area and distribute the water more widely. Fog nozzles are usually used to control fires involving flammable liquids, although foam equipment is also used for such fires.

Water Additives. Fire fighters often add various chemicals to water to improve its ability to extinguish fires. If wetting agents are added to the water, the surface tension is reduced, making the water more penetrating and facilitating the formation of small drops necessary for rapid heat absorption. By adding foam-producing chemicals and liquids to water, a fire-blanketing foam is produced.

Foam is used to extinguish fires in combustible liquids, such as oil, petroleum, and tar, and for fighting fires at airports, refineries, and petroleum distribution facilities.

A recent development is a chemical additive that expands the volume of water 1000 times. This high-expansion foam is useful in fighting fires in basements and other difficult-to-reach

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areas because the fire can be smothered quickly with relatively little water damage.

Private Fire Protection. Commercial and industrial buildings usually have some sort of internal, or private, fire protection system installed. The automatic sprinkler system offers the most effective protection because it not only detects fires but also automatically applies water to extinguish or control them. Sprinkler systems are nearly 100 percent effective. Many sprinkler systems are supervised electrically from a central station, and alarms are transmitted to the fire department whenever the sprinklers operate or when a valve in the sprinkler system closes for any reason. A prime responsibility of a fire officer arriving at a fire is to insure that the sprinkler system is receiving sufficient water and pressure. If not, a pumper is connected to the sprinkler system, supplying additional water, usually at a pressure of 150 lb. per square inch.

Many high-rise or other large buildings have an internal system of water mains (standpipes) connected to fire-hose stations. Occupants of the building operate the hoses until the fire department arrives. Firemen can also connect their hoses to outlets near the fire.

Buildings may also be equipped with fire- or smoke-detection systems. These report unusual conditions to a central station or guard room. The alarms are set off by various activating devices, including fixed-temperature, heat-sensitive devices, smoke-detection devices, photoelectric cells, infrared detectors, and ionizing devices.

Salvage. This term refers to the methods by which firemen protect merchandise, household goods, and the interiors of buildings from smoke and water damage. Objects are covered with waterproof covers, and water is removed by water vacuums, mops, squeegees, water chutes, and portable pumps. Almost all fire departments carry salvage equipment in their apparatus. Fire departments in some large cities maintain special salvage companies.

Fire Prevention. The primary duty of a fire department is the prevention of fires. All firemen are trained in basic fire-prevention methods, and each fire company has an assigned inspection district in which it attempts to prevent or correct unsafe conditions. Fire departments are charged with enforcement of the local fire-prevention code and, frequently, of the State fire laws and regulations.

A fire-prevention bureau in the fire department usually directs fire prevention activities. It handles the more technical fire-prevention

problems, maintains the appropriate records, investigates the causes of fires, and conducts public-education programs. All commercial or multiple-dwelling buildings are inspected at regular intervals, and orders are issued for the correction of violations of fire laws. If necessary, court action is taken to compel compliance.

In communities protected by volunteer or part-time paid fire departments, fire prevention is usually the responsibility of a state or county fire marshal or of a professional fire staff in an otherwise voluntary organization.

In addition, fire departments usually inspect commercial buildings for what is called pre-fire planning. Private dwellings may also be inspected as part of the fire department's educational program to impress the importance of fire safety upon the inhabitants and to check for any unsafe conditions.

Fighting Forest Fires. Forest fires, like other fires, spread by the transfer of heat to grass, brush, shrubs, and trees. The object of fire-fighting crews is to prevent or control the extension of the fire and extinguish it if possible. Because it is frequently difficult to extinguish a forest fire by attacking it directly, the principal effort of fire fighters is often directed toward controlling its spread. This object is accomplished by creating a gap, or fire line, that the fire cannot cross. Fire lines are chosen and the fire crews attempt to stop the fire with the means at their disposal. These include direct attack with hose streams, aerial bombing, trenching, spraying of fire retardant chemicals, and controlled back-burning. As much as possible, advantage is taken of streams, open areas, and other natural obstacles when establishing a fire line. Wide firebreaks may be dug with plows and bulldozers. The sides of the firebreaks are soaked with water or chemicals to slow the combustion process. Some parts of the fire may be allowed to burn themselves out. Fire-fighting crews must be alert to prevent outbreaks of fire on the unburned side of the firebreaks.

Fire-fighting crews are highly trained and organized to handle fires covering large areas. They establish field command posts, commissaries, and supply depots. Two-way radios are used to control operations and airplanes are used to drop supplies as well as chemicals. Helicopters are used as command posts and for transporting fire fighters and their equipment to areas that cannot be reached quickly on the ground.

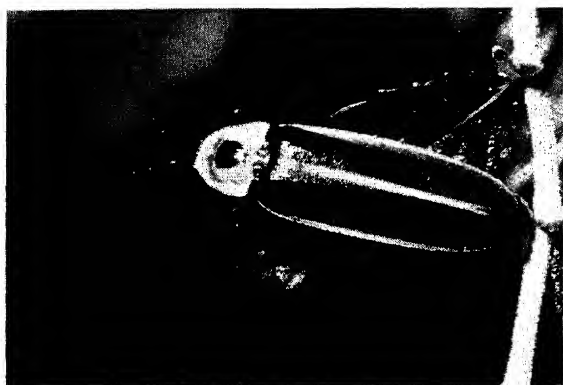
The United States Forest Service maintains several research laboratories that develop improved fire-fighting equipment and techniques,

and it also operates a school that trains fire fighters in the latest fire-fighting techniques.

W.Y.K.

FIREFLY, or **LIGHTNING BUG**, common name of light-producing beetles of the families Elateridae and Lampyridae, especially of the latter, which is known as the lightning-bug family. The luminosity of fireflies is most evident during warm nights, and it is the result of a complex chemical reaction.

The fireflies in the family Elateridae all belong to the genus *Pyrophorus* (which also contains nonluminous species) and are found mainly on the American continent. The tropical cucujo, *P. noctilucus*, has two yellowish, eyelike organs on each side of the prothorax through which light shines. Although the ventral abdominal surface is also luminous, the light is evident only when



Fireflies produce light without heat, a phenomenon known as luminescence.

Richard Parker—
National Audubon Society

the insect is in flight. These large tropical beetles, which are blackish brown and almost 2 in. long, are called fire beetles.

The beetles of the family Lampyridae are abundant in Europe and in most parts of the United States. They are small and flat, with serrate antennae and soft elytra (wing covers), which are often only partially developed. The light-producing area is usually situated on the sides of the abdomen. The color of the light is generally greenish white and it is produced intermittently. A common North American species is *Photuris pennsylvanica*, which is about ½ in. long. It is yellowish brown, with faint, lengthwise, darker stripes.

In fireflies of some genera, such as *Phenogodes*, the adult females show larvalike characteristics, such as the absence of wings. In other genera the true larvae themselves have luminosity. These luminescent larvae and wingless females, of which about 500 species are known,

are commonly called glowworms. The most familiar European species is the common glowworm of England, *Lampyris noctiluca*, of which the female is black and about ½ in. long.

FIRE INSURANCE, insurance used by home owners and owners of commercial property to obtain reimbursement for losses resulting from fire. Fire insurers assume the risk of partial or complete loss by fire in exchange for the payment of a premium. Five types of insurers write fire insurance, namely, stock companies, mutual companies, reciprocal exchanges, Lloyd's organizations, and advance premium cooperatives; see **INSURANCE: Types of Insurers**. About 85 percent of the fire insurance in the United States is written by stock companies. Some business firms, however, are self-insurers; that is, they set aside funds to be used exclusively for indemnifying losses resulting from fire.

The first scientific system of obtaining funds to compensate for fire loss was developed after the great fire in London in 1666, which devastated some 13,000 buildings. In the system inaugurated the following year by Nicholas Barbon (d. 1698), a merchant of London, small sums of money were collected from many individuals. Thus a fund was established for compensation of the losses sustained by the few whose property subsequently was partly or totally destroyed by fire. The first effective fire-insurance company established in the U.S. was the Philadelphia Contributorship for the Insurance of Houses from Loss by Fire, which is still in operation. It was organized in 1752 by the American scientist, philosopher, and statesman Benjamin Franklin (q.v.). The use of fire insurance became widespread during the 19th and 20th centuries.

The standard fire-insurance policy was adopted in New York State in 1943. It became the prototype for such policies in most other States either through statute or through regulation by State insurance departments. The resulting standardization has helped reduce litigation on disputed claims by making the insurance coverage more understandable to the policy holder and by simplifying adjustment of losses.

The basic fire-insurance policy covers losses resulting directly from damage or destruction by fire or lightning. In the early 1900's insurance companies in the U.S. first offered, for an additional premium, to extend the coverage of fire-insurance policies to other perils by the use of an endorsement on the policy. By the late 1920's these additional perils were incorporated into a so-called extended-coverage endorsement. Extended coverage at present includes the perils of damage by windstorm, hail, explosion, riot,

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strikes, civil commotion, aircraft, vehicles, and smoke. The endorsement may also be extended further.

In fire insurance the premium rates are of two types, namely, class rates and schedule rates. Dwellings are largely class rated; that is, they are grouped into fairly homogeneous categories according to the type of occupancy, type of construction, and type of community fire protection. A uniform rate is applied to all risks in the same category. Commercial and industrial properties, which vary greatly in respect to degree of hazard, are usually schedule rated. In schedule rating the individual physical characteristics of each risk are appraised according to a schedule of charges and credits. Factors considered in the rating include occupancy, construction, internal protection, community fire protection, and exposure from neighboring buildings.

A frequently issued policy is the home owners package policy, that combines fire, extended coverage and other perils, theft, and comprehensive personal liability in one policy. This policy results in a savings to the policyholder and eliminates overlapping coverages. Similar package policies are available for commercial use.

In recent years many owners of residential and business properties in congested inner-city areas have been unable to obtain adequate insurance coverage for fire, vandalism, burglary, and theft. Under the Federal Housing and Urban Development Act of 1968, insurance companies and State regulatory authorities are encouraged, through a Federal program of reinsurance, to set up Fair Access to Insurance Requirements (FAIR) plans, through which residents of low-income areas may obtain the insurance they need. If damage is caused by riot or civil commotion, the Federal government will reimburse the insurance company for its losses. Thirty-four States now have such plans. A.T.R.

FIRE ISLAND, or GREAT SOUTH BEACH, sand barrier beach of New York State, in Suffolk Co., Long Island. Noted as a summer resort, 50 miles E. of New York City, it lies between the Atlantic Ocean and Great South Bay, 5 to 7 mi. off the mainland and extending E.N.E. for about 30 mi. The maximum width of the sand strip is $\frac{1}{2}$ mi.

Ferries from Long Island serve the island's many summer communities. It is the site of Robert Moses State Park, Smith Point County Park, and a Coast Guard Reservation. Bridges connect the two parks with Long Island. The name "Fire Island" may derive from fires lighted there as warnings to passing ships.

See FIRE ISLAND NATIONAL SEASHORE.

FIRE ISLAND NATIONAL SEASHORE, recreational area of New York State, on Fire Island (q.v.). Extending from Robert Moses State Park east to Moriches Inlet, the seashore includes most of the 30-mi.-long island, with the exception of the coast guard, State, and county properties and the established residential communities. The region is a nature preserve and offers limited bathing, boating, picnicking, and fishing facilities. Established September, 1964, the seashore obtained an additional 577 acres in Brookhaven, Long Island, in 1965. This acquisition included the estate of General William Floyd (1734-1821), a signer of the Declaration of Independence. The seashore covers 19,311 acres, of which only 2158.15 are Federally-owned. It is administered by the National Park Service (q.v.).

FIRENZE, Italian name of Florence (q.v.).

FIREPROOF CONSTRUCTION, construction of buildings which resist damage by and prevent the spread of fire. Strictly speaking, truly fireproof buildings do not exist, because most noncombustible materials employed in construction suffer some damage under the action of heat and flame. A so-called fireproof building containing only nonburning components such as steel, terra cotta, plaster, and concrete may be completely wrecked by an intense fire in adjacent buildings. It may also be gutted by an interior fire which feeds on fixtures and trim only but which spreads through the building if the building is improperly designed. Two factors must be considered in fire-resistant construction: design and materials.

A building should be designed so that the interior is suitably subdivided by fire-resisting walls, floors, and partitions. Thus a fire starting in one part of the building will be limited in its spread. Elevator and stair shafts, walls, light wells, and other vertical structures within the building must be isolated from the main body of the building. Such design is essential for fireproofing because any vertical opening acts as a chimney, increasing the intensity of a fire and carrying the flames from floor to floor. Stairwells or shafts that must be continuous are isolated from the rest of the building by heavy, fire-resistant walls. Good design demands that walls should be solid or, if they are hollow, that they should be provided with a number of horizontal partitions, or fire stops, so that they will not act as flues. All doorways or other openings into the walls are provided with doors or covers which are either self-closing or which close automatically in the event of a fire. See also BUILDING CONSTRUCTION.

FIRESTONE, Harvey Samuel (1868–1938), American industrialist, born in Columbiana County, Ohio. At the age of twenty-seven he became president of the Firestone Rubber Company, Chicago, Ill., with which he remained associated for four years. Then in 1900, hiring seventeen workers, he formed the Firestone Tire and Rubber Company, Akron, Ohio. He served from 1903 until 1932 as president and from 1932 until 1935 as chairman of the board of directors. By 1935 the main corporation employed 40,000 people, controlled many subsidiary companies in the United States, and had established branch firms in foreign countries. At the instigation of Firestone the rubber-growing potentialities of the Philippines and of South American countries were assessed and much American capital was invested in the development of the rubber industry in those countries. In 1926 Firestone leased 1,000,000 acres in Liberia, West Africa. In the next decade he established rubber plants on 60,000 acres of that area (see *LIBERIA: The Economy*). As president of the Rubber Association of America from 1916 until 1918 he directed the conversion of the rubber industry for wartime production during World War I. Among his writings are *Rubber, Its History and Development* (1922).

FIRE WALKING. See *FIRE WORSHIP*.

FIREWORKS. See *PYROTECHNICS*.

FIREWORM, caterpillar of certain small moths, especially the species *Rhopobota naevana*, of the family Tortricidae. The caterpillar is less than 1 in. long. The moth has a small fat body, very thin antennae, broadly elliptical wings, and a scaly cluster at the end of its abdomen. The fireworm devours cranberry foliage in so voracious a manner that the vines finally appear as though burned. *Rhopobota vacciniana* or blackhead and *Peronea minuta* or yellowhead are related species of fireworms. Cankerworms (q.v.) are also called fireworms.

FIRE WORSHIP, religious devotion to fire as a divine or sacred element. Like sun worship (q.v.), from which it cannot always be distinguished, the veneration of fire is one of the most primitive forms of religion. The flame itself may be the object of adoration, or it may be regarded as the material manifestation of a divinity or fire spirit.

In the mythology of almost every people is an account of the method by which fire was brought to mankind. Thus the Greek Titan Prometheus (q.v.) is represented as having stolen

Persian fire worshipers (from a 19th-century book-illustration).
Bettmann Archive



FIRE WORSHIP

the precious flame from Mt. Olympus (q.v.), the home of the gods, or as having ignited a torch from the burning rays emitted by the chariot of the sun god Phoebus. A legend among the Polynesian Cook Islanders of the South Pacific describes the descent of the culture hero Maui to the underworld, where he learns the art of making fire by rubbing two sticks together; see POLYNESIANS. Primitive inhabitants of the Caroline Islands believed that man received fire from the gods through the bird Mwi, which brought it to earth in its bill and secreted it inside trees. Man then obtained this fire by rubbing two pieces of wood together. The Indian tribes of America, like the natives of West Africa, paid homage to ancestral fire spirits. The Aztecs (q.v.) of Mexico acknowledged in their worship the fire god Xiuheuctli, who resembled their divinity of the sun. The Incas (q.v.) of Peru also worshiped a fire god. Various Semitic peoples propitiated the fire god Moloch (q.v.) with the sacrifice of their firstborn children, and ritual oblations to their own fire gods were made by the Egyptians (see EGYPTIAN RELIGION) and other peoples of the ancient world. Fire worship occupied a central position in the religious rites of the early Indo-European peoples. Among the pre-Hindus, sacrifice to the fire was one of the first acts of morning devotion, and the hymns addressed to the fire god Agni outnumbered those in praise of any other divinity. The ancient Greek cults of Hestia (q.v.), goddess of the hearth, and Hephaestus (q.v.), god of fire, like those of their Roman counterparts, Vesta (see VESTAL VIRGINS) and Vulcan (q.v.), were integral features of the religion of classical times. Fire worship also was generally practiced among the ancient Slavic peoples, and the Celts of old offered prayers to Bridget as the patroness of fire, hearth, and fertility.

The worship of fire had its fullest development, however, in ancient Persia (now Iran), where from earliest times the ceremonial keeping of the flame was the chief characteristic of the Zoroastrian religion (see ZOROASTRIANISM). Fire was believed to be the earthly manifestation of the Divine, the heavenly light. The term for "priest" in the Zoroastrian scriptures is *athravan*, "belonging to the fire". The conquest of Persia by the Muslims was symbolized by the extinction of the holy flame in the Persian temples, and when the Parsees (q.v.) fled as religious exiles from their native land to India, the sacred fire they carried with them was as much a sign of their nationality as of their faith.

Closely associated with fire worship is the religious ceremony of fire walking. Practiced by

many peoples in all ages, it is still performed in such places as Tahiti, Trinidad, Mauritius, the Fiji Islands, India, and Japan. The ceremony consists in the procession of a priest and other celebrants barefoot across large stones that have been heated upon a bed of burning fagots. Various explanations, none of them altogether satisfactory, have been adduced to account for the fact that the fire walkers apparently suffer no burns or pain. Some observers have invoked the hypothesis of a religious ecstasy in the celebrants that produces temporary insensibility to pain. A member of the Smithsonian Institution (q.v.) who witnessed the ceremony in Tahiti in 1901 said that volcanic rock, over which the fire walkers march, is a poor conductor of heat, and that, therefore, while the stones of the ceremonial oven may be intensely hot underneath, the surface is only warm. In ancient times, particularly in India, the rite is said to have involved passing through the flames, rather than walking upon them. Some authorities believe that participants may have been able to walk through the flames without being touched by them.

FIRST AID, temporary emergency measures serving to assist the victim of sudden illness or injury until more skillful treatment is available. The purpose of first aid is to ease the victim's pain and anxiety and to prevent deterioration of his condition. In extreme cases first aid may be required to prevent death before medical assistance can be obtained.

First-aid measures vary according to the needs of the victim and the knowledge and skill of the person giving the treatment. Knowing what not to do in an emergency is as important as knowing what to do, since a first-aid measure misapplied may lead to serious complications. In an acute attack of appendicitis, for example, even a mild cathartic or the application of heat to relieve pain endangers the patient's chances of recovery.

Despite the wide variety of possible injuries, several principles of first aid apply in general to all emergencies. It is important to avoid panic or undue haste. Unless the position of the victim exposes him to further harm, the victim should not be moved until the nature of his injury has been determined. A competent person trained in first aid may examine the victim for wounds, burns, and fractures. If the victim is conscious, he should be reassured that medical aid has been summoned. The victim's head should be kept at body level unless he complains of difficulties in breathing; only in the absence of a skull or spine injury may the victim's head and shoulders be raised slightly to make him more

comfortable. If vomiting occurs, his head may be turned to one side. No liquids should be given to an unconscious person. Immediate relief must be provided in such serious conditions as asphyxia, severe bleeding, and poisoning to prevent loss of life.

Whatever the injury, in severe cases the victim must be protected against shock (q.v.). Shock is the depressed condition of many body functions due to the failure of enough blood to circulate through the body following serious injury. The symptoms of shock are pale and clammy skin, bluish lips, weak but rapid pulse, shallow breathing, and nausea. These symptoms may not be apparent immediately, as shock may develop several hours after the accident. To avoid this serious complication, which may result in death, the victim should be kept warm by using blankets or coats to cover him when necessary in order to maintain a normal body temperature. If there is no abdominal injury, the victim may be given sips of hot drinks such as milk, broth, tea, or coffee. Stimulating drugs and alcohol should not be administered.

The emergencies most frequently requiring first aid are caused by accidents involving asphyxiation, severe bleeding, poisoning, burns, heatstroke and heat exhaustion, fainting and coma, sprains and fractures, frostbite, and animal bite.

Asphyxiation. In asphyxiation air is prevented from reaching the lungs, and the supply of oxygen is cut off from the circulating blood. Among the causes of asphyxiation are drowning, gas poisoning, overdose of narcotics, electrocution, choking, and strangulation. Stoppage of heart action does not ensue immediately after the victim stops breathing, but to prevent irreparable brain damage resulting from the lack of oxygen, artificial respiration must be started immediately. Most persons will die within four to six minutes after breathing ceases unless artificial respiration is administered.

Many forms of artificial respiration have been devised; see RESPIRATION, ARTIFICIAL. The most practical method of artificial resuscitation is the mouth-to-mouth technique in which the operator forcefully exhales air into the victim's lungs. When present, foreign matter is quickly wiped from the mouth. The victim's head is tilted backward by the operator's placing one hand under the victim's neck and lifting, while the other hand is placed on the victim's forehead pressing downward. The victim's nostrils should be pinched together with the operator's fingers to prevent leakages of air. The operator takes deep breaths and, with his mouth sealed over

the victim's, exhales. The victim's chest can be seen to rise; then the operator removes his mouth and listens for the victim to exhale. This process is repeated at a rate of about 12 times per minute in adults and about 20 times a minute for children, with less pressure and volume being used for the children.

If the airway is not clear, the operator should recheck the position of the victim's head. If ventilation is still not accomplished, the operator should turn the victim to the side and apply sharp blows between his shoulder blades to dislodge obstructions. The mouth-to-mouth blowing effort should then be repeated.

Once begun, artificial respiration must not be interrupted until the person begins to breathe or a doctor pronounces him dead. When the victim begins to breathe spontaneously he should not be moved; artificial respiration may be needed to aid abnormal breathing. See ASPHYXIA.

Severe Bleeding. Welling or spurting blood is the unmistakable sign of this emergency. The presence of blood over a considerable area of the victim's body is not a reliable indication of hemorrhage. The blood may be oozing from multiple small wounds or it may have been smeared, giving the appearance of serious loss of blood. The rate at which blood is lost from a wound depends on the size and kind of blood vessel ruptured. Injury to an artery may be identified by bright-red, spurting blood, in contrast to the welling, dark-red blood from a vein. In case of an arterial rupture the victim may bleed to death within a minute. Venous and minor arterial injuries have a less critical time limit but, if left unattended, also may be fatal. A serious consequence of extensive bleeding is shock, which must be considered as soon as the flow of blood has been checked.

The procedure used to stop bleeding depends on the size of the wound and on availability of first-aid materials. The preferred method is by application of pressure over the wound itself and by elevating the bleeding part when possible. This procedure is most effective on wounds involving medium-sized blood vessels. If possible, a pad of sterile dressing or clean cloth is held firmly in place by means of bandages on the bare wound. Dressings that become saturated with blood should not be removed but may be reinforced with additional layers. If no dressing material is available or if the victim is rapidly losing blood from a wound on one of the extremities, pressure may be applied to the blood-supplying artery at a particular spot, called the pressure point, at which the artery

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passes close enough to the skin to permit its compression against the underlying bone.

The major pressure point on the brachial artery, which supplies blood to the arm, is located approximately halfway between the elbow and the armpit on the inner side of the arm. Severe bleeding from a wound of the hand or the lower arm may be checked by grasping the arm firmly between the thumb and the fingers, which are placed over the pressure point. The major pressure point on the femoral artery, which supplies blood to the leg, is situated on the front center part of the diagonally slanted "hinge" of the leg, in the crease of the groin area, where the artery crosses over the pelvic bone. The heel of the hand pressed firmly at this point stems the flow of blood from a leg wound. The two arterial branches that supply blood to the head are the temporal and the facial artery. Circulation of the blood to the face may be impeded by pressing against the underside of the lower jawbone, about an inch in front of the angle of the jaw, with the side of the index finger or of the hand. Bleeding of the head above the eyes may be checked by pressure applied at a point just in front of the ear. See BLEEDING.

Poisoning. A poisonous substance, introduced commonly into the body through the mouth, causes such symptoms as nausea, cramps, and vomiting. Poisons taken accidentally or with suicidal intent include toxic medications, insecticides, rodenticides, and household disinfectants.

To aid a person who has swallowed a poisonous substance, it is of primary importance to identify the poison, either by questioning the victim or by searching for an empty medicine bottle or container. Containers of many poisonous substances list the antidote on the label. Burns, stains, or a characteristic odor also may lead to recognition of the poison.

The first measure to be taken is to dilute the poison, whatever type is involved, by forcing the victim to drink a large amount of milk or water, or both. Dilution delays absorption and spreading of the poison to vital organs.

Except in those cases involving strong acids or alkalis, strychnine, or kerosene, the next step is to induce the victim to vomit and expel as much of the poison as possible before it spreads throughout the system. Vomiting may be promoted by giving the victim several teaspoonfuls of baking soda or milk of magnesia in half a glass of water, or by introducing the finger or a spoon far enough into the mouth to cause gagging. This procedure should be repeated until all the poison is ejected from the stomach and

may be followed by a cathartic such as Epsom salts.

Another measure of first aid in poisoning is to counteract the poison with an antidote. Some antidotes serve to isolate the toxic substance from the sensitive mucous membranes of the body; others react chemically with the poison and transform it; and still others act upon the body itself, inducing it to counteract the poison. If the specific antidote is unavailable or cannot be determined, a universal antidote that counteracts the majority of poisons may be utilized; it consists of one part strong tea, one part milk of magnesia, and two parts powdered burnt toast. The universal antidote is also commercially produced.

When the poison is a corrosive acid, such as hydrochloric, nitric, or sulfuric acids, or an alkali such as caustic soda, or ammonia, no effort should be made to induce vomiting, as it would inflict further damage to the injured tissues of the mouth and throat. A weak alkali, such as lime water, bicarbonate of soda, or milk of magnesia, may be given as an antidote for acid poisoning, and a mild acid, such as orange or lemon juice or diluted vinegar, may be given to neutralize alkaline poison. After administration of these antidotes the victim may be given olive oil or egg white. Vomiting also is contraindicated in strychnine or kerosene poisoning, for which olive oil or egg white may be administered, following dilution with water or milk. See POISON.

Burns. Common causes of burns include exposure to fire, hot metals, radiation, chemicals, and electricity. Burns are classified according to the depth of the tissue damage and the extent of the involved area. A first-degree burn, which involves only the surface of the skin, is characterized by reddening, a second-degree burn by blistering, and a third-degree burn by charring and destruction of the cell-producing layer of the skin. The severity of a burn depends also upon the involved area, which is expressed as a percentage of the total body surface. Severe burns cause shock and loss of body fluids. A person suffering third-degree burns involving more than 10 percent of the body surface should be hospitalized as soon as possible.

The object of first aid in burns is to prevent shock, contamination of the burned tissue, and pain. Application of ice packs or immersion in ice water eases pain. Then a thick sterile dressing without medication may be applied to the burned area to further prevent contamination. In the treatment of severe burns, wet dressings or ointments should be avoided. Instead, sterile dressings should be applied and bandaged in

The techniques of first aid vary with training and the needs of an injured person. Back pressure arm-lift (Fig. 1) and mouth-to-mouth (Fig. 2) methods of artificial respiration are both widely used. In emergencies, a tourniquet (Fig. 3) may be used to prevent excessive bleeding from wounds of extremities. A loose knot is tied (1) and a stick or other straight object slipped through the loop (2). The stick is rotated clockwise to increase pressure and reduce blood flow. In emergency situations, splints should be applied (Fig. 4) even though a fracture is only suspected, to reduce danger of further injury.

U.S. Public Health Service

place, and medical attention should be sought immediately.

The degree of injury from a sunburn usually does not range beyond painful blistering. For cases of mild sunburn the application of cold cream or, in an emergency, salad oil or shortening brings relief; more serious cases should be seen by a doctor. First aid for chemical burns begins with immediate and profuse bathing of the burned parts to dilute and remove the corrosive chemical. Electrical burns should be treated in the same manner as burns from exposure to fire.

Heatstroke and Heat Exhaustion. Both these conditions are caused by excessive heat, but their symptoms are in such direct contrast that mistaken diagnosis is most unlikely. Heatstroke (q.v.), or malfunction of the heat-control centers in the body, occurs less frequently than heat exhaustion and is a more serious condition which commonly affects elderly persons. The symptoms of heatstroke are hot and flushed skin, absence of perspiration, strong, drumming pulse, labored breathing, dilated pupils, and extremely high temperature. The affected person feels dizzy and may lose consciousness. Heat exhaustion is due to excessive loss of body fluids and body salts. Its symptoms are clammy, pale skin, profuse perspiration, weak pulse, and shallow breathing, but the pupils and temperature are close to normal. Headache and vomiting may occur.

First-aid measures for heatstroke differ from those applied in heat exhaustion. The victim of heatstroke must be taken to a cool spot, preferably indoors, and placed at rest with his head elevated. His body should be sponged with alcohol or cool water to reduce body temperature. Arrangements must be made immediately to transport the heatstroke victim to the hospital. In heat exhaustion rest also is indicated, but the head should be lower than the body, and external heat should be applied. The person suffering from heat exhaustion may be nauseated at first, but after resting a while he can retain fluid. Salt tablets or a solution of half a teaspoon of salt in half a glass of water may be given to the patient



Fig. 1.

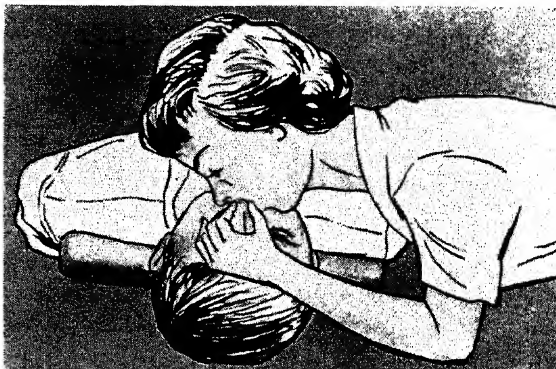


Fig. 2.

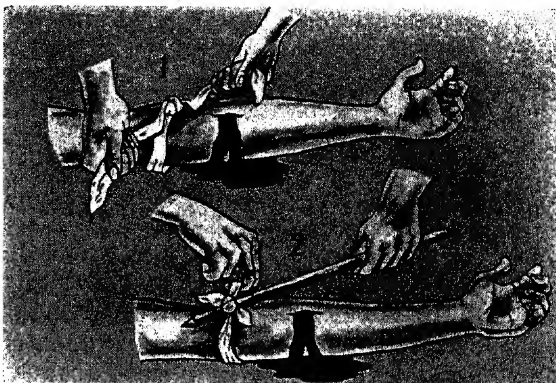


Fig. 3.

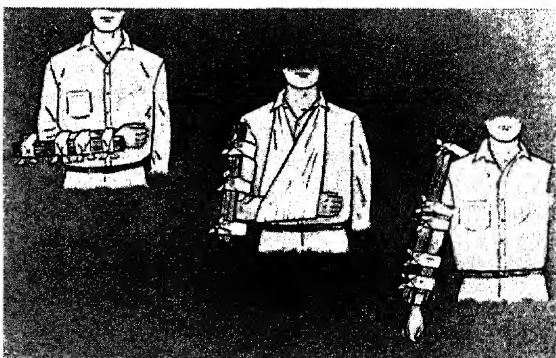


Fig. 4.

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at fifteen-minute intervals for an hour, followed by fruit juices to restore the body fluids lost by dehydration. In case of severe prostration, medical care is required.

Fainting and Coma. Cold perspiration and pallor are indications of fainting (q.v.). Fainting is caused by insufficient blood circulation to the brain and is temporary. To restore circulation, the unconscious person's feet are elevated, or the head is lowered below the level of the heart. The victim must be kept from becoming chilled. Spirits of ammonia may be held briefly to the nose. When the victim revives he may be given hot tea or coffee.

A deep state of unconsciousness due to illness or injury is known as coma (q.v.). Comatose persons cannot be aroused by external stimuli such as spirits of ammonia. Some states of coma resemble simple fainting but call for different medical procedures. Pathological unconsciousness can be caused by heart failure, cerebral hemorrhage, epilepsy, diabetic seizure, skull fracture, and any of the emergency conditions described above. First-aid treatment for coma is limited to keeping the unconscious person quiet and making him comfortable by loosening his clothes until medical assistance can be secured. If the victim's face is flushed, his head and shoulders may be raised slightly. Conversely, if the victim has a pale face, his feet may be slightly elevated. In epilepsy, all the first-aiders can do is to protect the victim of a seizure from injuring himself. If breathing ceases, artificial respiration should be administered. Diabetic patients often carry identification cards, indicating the cause of unconsciousness.

Sprains and Fractures. Great pain and swelling characterize both a sprain and a fracture (qq.v.), but inability to move the affected part and unnatural twisting often are indicative of a bone break. Until a bone break has been ruled out, a severe sprain should be treated as a fracture. Frequently incomplete or partial fractures occur with bad sprains, and only an X ray can provide safe diagnosis.

A fracture is caused by sudden, violent pressure on the bone, whereas a sprain occurs when a bone is suddenly wrenched at a joint. All severe sprains are accompanied by tearing of ligaments or fibers around the joint. Because the slightest movement of the affected parts causes the injured person great pain and may increase the damage, no attempt should be made to straighten or move broken limbs until arrival of medical help. To prevent the ends of the bone from tearing blood vessels, splints should be used to immobilize the broken parts and the ad-

jacent joints if the injured person must be transported to the hospital. Splints can be improvised of light, smooth boards, folded cardboard, or similar material, tied to the broken part with a strip of cloth.

If the head or body of the victim is twisted in an unnatural position, a fracture of the spinal column may have taken place, and any attempt at straightening or moving the body may be fatal. Other signs of a broken spinal column are severe pain in the back or in the neck and paralysis of the lower extremities.

Animal Bite. Noteworthy offenders in biting man are snakes, dogs, cats, and small rodents such as squirrels.

Many snakebites are caused by nonvenomous snakes and do not have to be treated beyond cleansing the wound and daubing it with a disinfectant. Infection, however, is always possible with any wound. Bites inflicted by venomous snakes require speedy first-aid measures.

The symptoms of a poisonous snakebite depend on the snake species. The bite of rattlesnakes, copperheads, and water moccasins injects venom which destroys blood vessels; the wound is characterized by immediate, sharp pain and swelling. If a large quantity of venom has been injected the swelling may become so pronounced as to break the skin. Discoloration of the tissue surrounding the bite is another unmistakable sign of this type of venom. The bitten person feels dizzy and nauseated and may go into shock. The bite of the coral snake may not cause immediate pain, but its venom attacks the central nervous system, paralyzing vital organs such as the lungs. Identification of the snake is helpful in determining the proper antitoxin, or snake-bite serum.

The objective of first-aid care is to prevent the venom from spreading through the system. The bitten person should be kept quiet to avoid increased circulation of the blood and thus of the venom. If the bite is in an extremity, a tourniquet should be applied 2 or 3 in. above the site of the wound. This constricting band should not be too tight to prevent the oozing of some blood from the wound.

Another method of retarding circulation of the venom is to keep the affected part at a lower level than the rest of the body. Cold water or ice water may be applied over the wound to relieve pain. If the bite is on the arm or leg, the wound should be washed thoroughly with soap and water and blotted dry. A sterile or clean dressing should be applied and bandaged in place. Early medical care is important to permit injection of an antitoxin.

Dogs, cats, and squirrels may carry the rabies virus; see **RABIES**. The attacking animal should be caught and delivered to the local veterinary authorities to determine whether it is rabid. If the attacking animal is not caught, the bitten person should assume that it was rabid and submit to antirabies inoculation without delay. The wound should be sterilized, and further contamination should be prevented with a clean dressing.

Frostbite. Slight reddening and tingling of the exposed skin precedes frostbite (q.v.). As frostbite develops, the skin of the affected part becomes pale gray or grayish yellow, and the initial pain subsides. Frequently the frostbitten person is unaware of his condition.

Immediate relief may be obtained by pressing the warm hand on the frostbitten part, but the traditional approach of massaging it or rubbing it with snow should be avoided. Any friction applied to the frozen part tends to injure the tissues. The victim should be brought indoors as soon as possible, and the frozen part should be rewarmed quickly in circulating water of 103° F. to 105° F. or in warm wet packs. Heat pads, heat lamps, or hot-water bottles should not be used, for their heat is too intense.

If the victim is numb and drowsy or unconscious, he must be wrapped quickly in prewarmed blankets or placed in a tub of warm water (78° F. to 82° F.). He should be dried thoroughly after immersion, by patting rather than rubbing. As the victim reacts to treatment, he may be given a hot liquid such as coffee, tea, or broth.

Plant Poisoning. After contact with a poisonous plant, the skin should be thoroughly washed with water. Chemicals such as potassium permanganate may be applied to neutralize the poison. Soothing lotions such as boric acid solution or calamine lotion may be used to allay the discomfort caused by itching. Severe cases may require medical attention and treatment. See also **PLANTS**, **POISONOUS**; **POISON IVY**, **POISON OAK**, and **POISON SUMAC**.

THE AMERICAN NATIONAL RED CROSS
FIRST CHURCH OF CHRIST, SCIENTIST. See **CHRISTIAN SCIENCE**; **EDDY**, **MARY BAKER**.

FIRST INTERNATIONAL. See **INTERNATIONAL WORKINGMEN'S ASSOCIATION**.

FIRTH OF CLYDE. See **CLYDE**.

FIRTH OF FORTH. See **FORTH**.

FISCHER, Bobby in full **ROBERT JAMES FISCHER** (1943–), American chess player, born in Chicago, Ill. He learned to play chess when he was six years old, and at the age of thirteen he became the youngest United States national

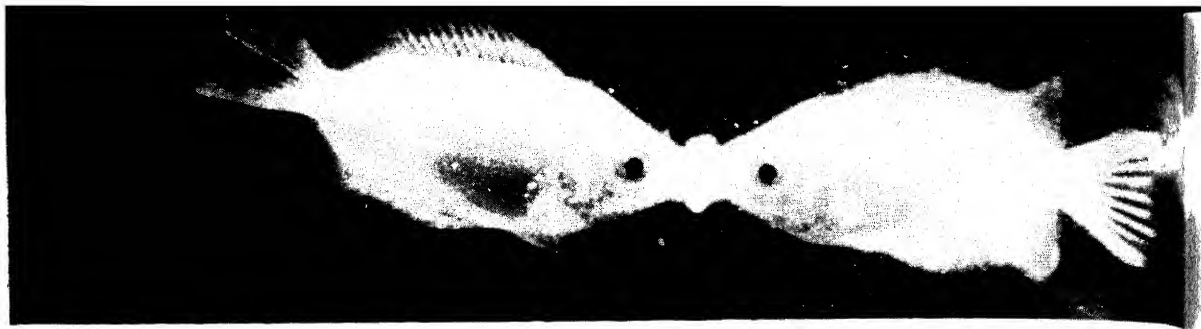
junior chess champion; at fourteen he was the youngest national senior champion. After becoming the youngest international grand master in the history of chess, Fischer left high school and established himself as the only chess player in the Western countries to earn a living solely by playing chess. Fischer set a modern tournament record by capturing the 1964–65 U.S. championship with a score of 11 matches out of 11. By 1968 he had won the U.S. championship eight times. In 1972 Fischer became the world champion by defeating the titleholder, Boris Spassky (1937–), of the Soviet Union in Reykjavík, Iceland. In 1975 the International Chess Federation refused to meet Fischer's conditions for a match with the Soviet challenger, Anatoly Karpov (1951–), and the title was awarded to Karpov; see **CHES**.

FISCHER, Emil Hermann (1852–1919), German chemist, born in Euskirchen and educated at the universities of Bonn and Strasbourg. He was a professor of chemistry at the universities of Munich (1879), Erlangen (1882), Würzburg (1885), and Berlin (1892). Fischer was the first to synthesize glucose and other simple sugars and to evolve the formulas of many purine derivatives such as uric acid, xanthine, and caffeine. He was also the first to hydrolyze the complex proteins into simple amino acids. For his work on sugar and protein synthesis, Fischer received the Nobel Prize in chemistry in 1902.

FISCHER, Ernst Otto (1918–), German chemist and Nobel laureate.

The son of a physics professor at the University of Munich, Fischer was born on Nov. 10, 1918. His studies were delayed by service in the peacetime German army and during World War II. After the war, he returned to Munich and studied at the Technical University. There he earned a PH.D. in 1952 and was given a professorship in 1957. In 1973 Fischer shared the Nobel Prize in chemistry with Geoffrey Wilkinson (q.v.) for the discovery, independently made, that metals could be merged with organic compounds to form organometallic molecules. A possible practical application of this work may be the use of less toxic metals than lead as gasoline additives.

FISCHER, Hans (1881–1945), German chemist, born in Höchst (now part of Frankfurt am Main), and educated at the universities of Marburg and Munich. In 1921, after teaching at various universities, he became professor of organic chemistry at the Technische Hochschule in Munich. He is best known for his investigations of chlorophyll and of blood, and for his synthesis of hemin, the substance in red blood



The gourami are also called kissing fish. What looks like a kiss, however, is possibly a sort of tug-of-war in which the fish test their strength by pushing and pulling each other by the jaws. UPI

corpuscles. In 1930 he was awarded the Nobel Prize in chemistry.

FISCHER-TROPSCH PROCESS. See HYDROGENATION.

FISH, common name of any aquatic, usually gill-breathing vertebrate animal of the phylum Chordata. All members of this group have skeletons composed of cartilage or bone, are equipped with gills for underwater respiration, and swim by means of fins. The term "fish" includes the Chondrichthyes such as the shark and ray, which have wholly cartilaginous skeletons. The name "fish" is erroneously applied to marine mammals such as the whale and dolphin (qq.v.), which are lung breathers.

ORIGINS AND ANATOMY

Fossil remains of fishes first appear in deposits of the Ordovician Period (q.v.), indicating that the earliest fishes developed at least 350,000,000 years ago. Fishes were among the first vertebrates to appear. During the Devonian Period (q.v.) primitive fishes, or fishes classified outside the Teleostei class, were the dominant form of animal life. Both marine and freshwater species were plentiful. The lobe-finned fish, crossopterygians, which developed in this period, were the first vertebrates to breathe air and were the ancestors of the first amphibians that appeared in the latter part of the period.

In general, fish are spindle-shaped, with bodies that are somewhat compressed at the sides and tapering more markedly at the tail than at the head. Typically, the body of a fish consists of a head, which terminates at the gill openings, a torso, and a tail. The body carries a number of fins, which are membranes stiffened by spiny rays. One or more dorsal fins are located along the center line of the back. A nearly symmetrical caudal fin lies at the end of the tail. One or more anal fins are situated on the center line of the belly of the fish behind the vent. The body has two pairs of lateral fins, the pectoral fins, which lie behind the gill openings, and the pelvic fins, farther back on the ventral side of

the body. Wide variations are found in both the shape and the anatomical details of the body of fishes. Some species, such as the fluke, are extremely flattened. Others, such as the eel, are elongated and snakelike. The fins are often modified to a great extent. For example, certain fins may be missing entirely or may be joined to form a single fin.

The various species of fishes also show extreme variation in size. Some tropical species are less than $\frac{1}{2}$ in. long when mature, and large Pacific tuna may reach a length of 10 ft. and a weight of 1500 lb.

Fishes vary greatly in coloring as well, displaying a wide range of hues and patterns. In general the coloration is lighter on the belly than on the back, but in water the fish appears to be of a uniform shade because the only light comes from above. A number of tropical fishes, notably the butterfly fish, are brilliantly colored and patterned. Their coloration serves as a protective camouflage (q.v.) among the corals and underwater plants of the seas in which they live. Many fishes have the ability to alter their colors markedly to blend with their environment. Flatfish have been observed changing color to match a checkerboard pattern on the bottom of an aquarium.

Many species of fishes have specially adapted shapes and special organs that aid them in hunting and feeding. Among such fish are the lantern fish and other deepwater fishes, which have luminous organs to reveal or attract their prey. The angler fish lies on the ocean bottom and presents a small knob of flesh on the end of a long spine as a bait to other fish.

Scales. The bodies of most fish are covered with a layer of scales, which are bony or horny plates arranged in overlapping rows, with the free posterior end of one scale overlapping the attached anterior end of the scale behind it. A thin epidermis usually covers the scales. In a number of species the scales develop into bony plates. In some species, such as the eel, the scales are minute. In other species, such as catfish, they are almost entirely absent.

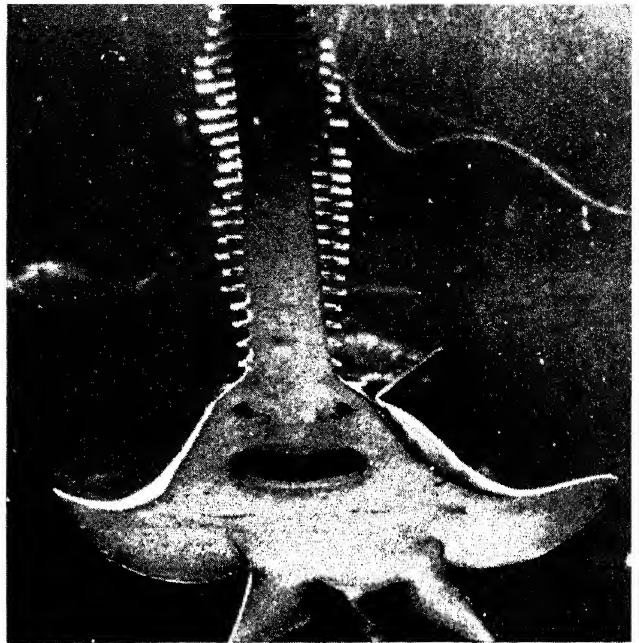
Fishes have sometimes been classified according to the shape and characteristics of their

scales. The most important types are ganoid scales, which are rhombic in shape and covered with an enamel-like layer; cycloid scales, which are almost round with smooth edges; and ctenoid scales, which are also round but have serrate or comblike exposed edges. The epidermal layer of the body contains the pigment cells that give the fish its color. Also in the epidermal layer are cells secreting a slimy mucus that covers the entire body.

Skeleton. The scaly integument covering the body of a fish is actually a form of exoskeleton, or outside skeleton, somewhat similar to the shells of crustacea (q.v.). The endoskeleton, or inner bony framework, of most modern fish consists of a skull, containing jaws equipped with teeth, a vertebral column, ribs, pectoral arch, and a series of interspinal bones that support the fins. In the primitive fishes, represented in modern times by such fishes as the sturgeon, the gar, and the lungfish, skeletons are cartilaginous rather than bony. Because the body is supported by water, fishes do not need the strong skeletons that characterize land-dwelling vertebrates.

Internal Organs. The digestive system of a fish usually consists of a mouth with rows of sharp, crushing, or brushlike teeth, a pharynx, an esophagus, a stomach, and an intestine terminating in an anal vent. The several organs of the alimentary canal are not sharply differentiated in all species. All species, however, have a pancreas and a liver.

The respiratory apparatus of all fishes consists of a series of slits, the gill clefts, which open from the pharynx to the gill chambers at either side of the back of the head. These chambers open to the water outside, but can be covered by flaps of outside skin called gill covers. Inside the gill chamber and in the gill clefts are the gills themselves, which assume the form of thin sheets or filaments through which the blood circulates. When the fish swallows water and expels it through the gills, oxygen passes into the blood through the thin gill membranes and carbon dioxide waste passes out of the blood into the water. Fish normally obtain oxygen that is dissolved in water. A few species, however, such as the lungfish, can breathe atmospheric air by means of a specialized, accessory respiratory apparatus, which consists of a modified air bladder functioning as a lung. In most fishes the air bladder, or swim bladder, is not an accessory breathing organ. It is a chamber that opens off the alimentary canal and fills with oxygen and nitrogen taken from the blood. The chief function of this organ in the great majority of spe-



The sawfish uses its snout, edged with razor-sharp teeth, to kill or stun smaller fish on which it feeds.

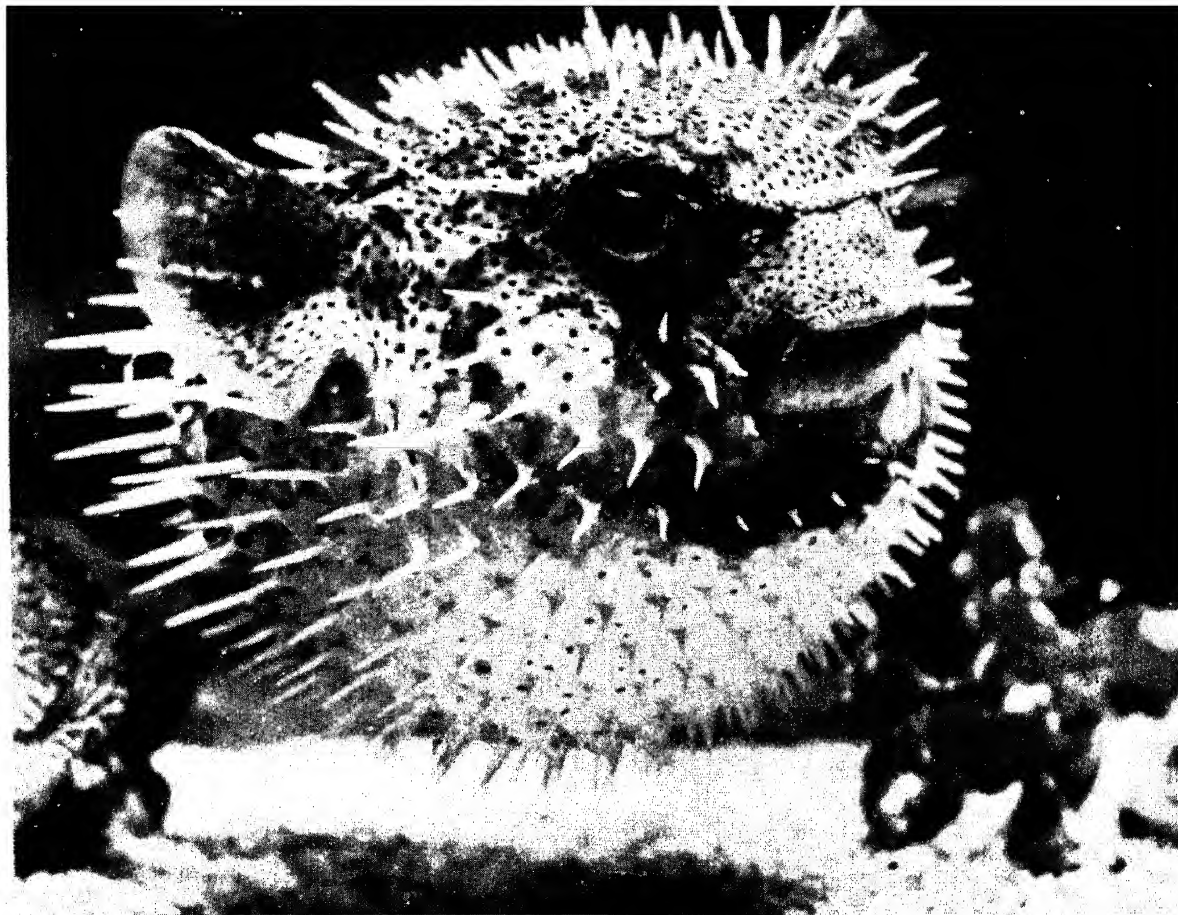
UPI

cies is to adjust the fish to the varying water pressures at different depths, so that the animal will have neither positive nor negative buoyancy. Thus the fish may maintain its depth without effort.

The circulatory system in most fishes is simple, consisting of a two-chambered heart, which forces blood forward through the gills, then to the head, and from the head back to the rest of the body through a major artery situated beneath the spine. The rate of circulation is slower in fishes than in other vertebrates.

Muscles. The chief muscles in the body of a fish are two pairs of longitudinal organs. The larger pair runs along the back at either side of the spinal cord, and the smaller pair is located below it. Each muscle is composed of a series of interlocking segments. In ordinary swimming the successive contraction of the muscle segments from front to back alternately on either side gives the caudal fin a sculling motion. Small auxiliary muscles control the motions of mouth, gills, fins (except the caudal fin), and eyes. In general only the caudal fin is used in swimming, and the others serve for steering and braking motions. Some fast-swimming fishes gain added speed from the force with which they eject water from their gills. A few types of fishes, such as the eel, swim by serpentine motions of their bodies. Certain others, among them the trunkfish, propel themselves by the action of their fins without body motion.

Nervous System. The central nervous system of most fishes consists of a brain that has a large



Above: When threatened by a predator, the porcupine fish, or blowfish, inflates its body by swallowing air and water, causing needle-sharp spines to rise and form a natural protective armor. Below, left: By filling a special bladder-like chamber with seawater, the balloonfish can double its size and make itself too unwieldy for an attacker to handle. Below, right: The beautiful fanning fins of the lionfish contain spines that can inject poisonous venom into an enemy.

UPI



cerebellum, a pair of optic lobes, a small cerebrum, a medulla oblongata, and a spinal cord. The form and size of various parts of the brain vary markedly in different species. The eyes have almost spherical lenses with a flattened cornea. The entire lens of the eye is moved inward toward the retina in order to focus on different objects. In general the pupils of the eyes of fishes are larger than those of other vertebrates. The enlarged pupil permits more light to enter the eye and allows the fish to see in the half-dark of deep water. The eyes of some cave fish that live in complete darkness are rudimentary and useless. Fishes smell by means of a pair of double nostrils leading into an olfactory pit. They lack a sense of taste, but have an immovable rudimentary tongue on the floor of the mouth serving as an organ of touch for identification of food.

Fishes hear without the aid of external ears. Sound vibrations are transmitted through the bones of the skull to an internal ear containing three semicircular canals. This inner ear acts as an organ of equilibrium as well as an auditory organ. Fishes are also equipped with unique sensory organs called lateral line organs. These organs consist of canals that run down the sides of the head and body and connect with the outside surface of the fish through small pores. The function of the lateral line organs is to sense slow movements of the water rather than sound vibrations.

Reproduction. Many fishes breed in large groups, coming together in a small area where the females eject their eggs, or roe, and the males their sperm, or milt. While maturing, the fertilized eggs float in the water. The spawning ground for each species of fish that breeds in this way is apparently determined by physical factors such as the temperature and salinity of the water. Eels descend streams to spawn in the ocean. Other types of fishes, such as the salmon, ascend freshwater streams from the sea during breeding season. Species that ascend streams usually lay their eggs on the stream bottom, covering them with sand or gravel after they are fertilized. The eggs of other fishes, particularly fishes that practice pairing, are protected by the parents in a number of ways. Male sticklebacks make nests out of bits of weed cemented together with a substance that they secrete from special glands. After the female has deposited her eggs in the nest and the male has fertilized them, he stands guard during their incubation. In other species the eggs are incubated in the mouth of the mother or in the gills or in special pouches. Sometimes the eggs are

attached to weed stems during the incubation period. Most species spawn during the spring months, but in the tropics the wet and dry seasons often determine the time of spawning. See EGG; EMBRYOLOGY.

FOOD

The food of fishes includes a great variety of animal and vegetable matter. Some species are omnivorous, whereas others confine themselves to one type of food such as a single species of crustacean. Many forms, such as the carp, eat only vegetable matter. A number of others, such as the trout and bluefish, are carnivorous and prey on smaller fishes. Some, such as the catfish, are scavengers, and a number of species feed exclusively on plankton.

DISTRIBUTION

Approximately 30,000 species of fishes are known, which is considerably more than the number of any other class of vertebrates. Fishes are widely distributed throughout the world, and it may be said they are found wherever there is water. By far the greatest number of species of oceanic fishes is found in tropical waters, and the majority of tropical species live in the Indian Ocean and the southwest Pacific Ocean. The fishes of the northern and southern temperate zones are in the main of different genera, but certain genera, such as the hake and the sardine, are found in both zones. The fishes of the arctic and antarctic belong to different genera entirely. Ichthyologists, or scientists studying fishes, usually divide the distribution of freshwater fishes into seven great zones, each of which has a distinctive fish fauna. These zones are Australia, Madagascar, Africa, southeastern Asia, Europe and the rest of Asia, Central and South America, and North America.

CLASSIFICATION

Fishes are classified differently by many zoologists. Some of the classifications are very complex and divide fishes into more than one hundred orders and suborders. In the most generally used system, the subphylum Craniata ("with cranium"), or Vertebrata, is divided into two superclasses: Agnatha, which includes the lamprey and other fishes without jaws; and Gnathostomata, which includes the fishes with hinged jaws. The latter are further divided into the class Chondrichthyes, cartilaginous fishes such as the shark, ray, and chimaera, and the class Osteichthyes, bony fishes. The bony fishes are made up of the subclass Sarcopterygii, lobe-finned fishes, and the subclass Actinopterygii, ray-finned fishes. The recent ray-fins consist of two groups, the Holostei, which includes the gar, bowfin, and sturgeon, and the Teleostei,

FISH

which comprises eight superorders as follows: Elopomorpha, including the eel, bonefish, and tarpon; Clupeomorpha, including the anchovy, herring, and shad; Osteoglossomorpha, including the salmon, pike, and smelt; Ostariophysi, including the arapaima, elephant fish, and mooneye; Protacanthopterygii, including the catfish, electric eel, minnow, and hatchetfish; Scopelomorpha, including the lantern fish and lizard fish; Paracanthopterygii, including the codfish, hake, toadfish, and trout-perch; and Acanthopterygii, including the John Dory, perch, rockfish, sea horse, sunfish, tuna, flatfish, killifish, livebearer, sculpin, and remora.

ECONOMIC VALUE

Fish is one of the most important of human foodstuffs, and a great majority of the fish caught in the oceans and in fresh water are used for food. Subsidiary uses of fish and fish products include the manufacture of nitrogenous fertilizer from fish and fish scraps and the extraction of fish-liver oils as one of the sources of vitamin D. Fish scales are sometimes used in the making of artificial pearls. Isinglass, a form of gelatin, is prepared from the air bladders of certain species of fish, and glue is made from fish offal.

See AQUARIUM; FISHERIES; FISHING; TROPICAL FISH; and separate entries on many of the fish mentioned in this article.

FISH, American family prominent in New York State and national politics.

Nicholas Fish (1758-1833), soldier and politician, born in New York City. For his participation in the American Revolution he was brevetted lieutenant colonel in 1783. From 1784 until 1793 Fish was adjutant general of New York State. In 1793 he was appointed supervisor of United States revenue for the New York district. He was elected alderman of New York City in 1806 and served in that position until 1817.

Hamilton Fish (1808-93), lawyer and statesman, son of Nicholas, born in New York City, and educated at Columbia College (now Columbia University). He was admitted to the bar in 1830. Fish served as a member of the United States House of Representatives from 1843 until 1845, as the governor of New York State from 1849 until 1850, and as a United States Senator from 1851 until 1857. He is most noted for his service as secretary of state under President Ulysses Simpson Grant (q.v.) from 1869 until 1877, especially for his handling of disputes with Great Britain and Spain. When the Treaty of Washington was drawn up in 1871 to settle the disputes that arose between the U.S. and Great Britain during the American Civil War, Fish took

an active part in arranging for the arbitration of the *Alabama* Claims (q.v.). Later he was instrumental in finding a solution to the San Juan Boundary Dispute with England, which was settled in 1872; see WASHINGTON, TREATY OF. During the Cuban insurrection against Spain, which dominated Cuban political life during the latter part of the 19th century, Fish was largely responsible for the recognition by the U.S. of the insurrectionists.

Hamilton Fish, Jr. (1888-), politician, grandson of Hamilton, born in Garrison, Putnam County, N.Y., and educated at Harvard University. He served in the New York State assembly from 1914 to 1916. During World War I Fish served in the army and was discharged in 1919 with the rank of major. From 1920 to 1945 he was a Republican member of the U.S. House of Representatives. After his retirement from political life, he entered the oil-development business.

FISH AND WILDLIFE SERVICE, an agency of the United States Department of the Interior charged with the protection and restoration of migratory and endangered species of wildlife. Organized for purely scientific purposes in 1885 as the U.S. Biological Survey, the role of the service, known as the F.W.S., was expanded to include a large number of conservation, propagation, and regulatory activities.

The F.W.S. oversees 370 national wildlife refuges that provide more than 30,000,000 acres of living space for all species of native wildlife. It also operates 90 fish hatcheries, 45 cooperative research units at State universities, and several research laboratories. At the Patuxent Wildlife Research Center near Laurel, Md., small numbers of whooping cranes, California condors, black-footed ferrets, and other highly endangered species are kept for study, restocking, and as a guard against the possibility of extinction. The center's computerized bird-banding section compiles migration patterns and causes of bird mortality for the entire North American continent. This information, plus annual surveys by American and Canadian biologists of the northern prairie waterfowl nesting grounds, is used to set duck and goose hunting regulations in the U.S. Treaties with Canada and Mexico ensure protection of migratory waterfowl from their northern breeding grounds to their southern wintering areas.

The F.W.S. distributes to State agencies funds from sporting-goods taxes for use in wildlife management and for hunter safety education. Its law enforcement division protects migratory birds, eagles, marine mammals, and endangered



Rainbow trout shown in a rearing pond at a Fish and Wildlife Service hatchery, prior to transfer to lakes and streams.
U.S. Dept. of the Interior

species. The endangered species division endeavors to restore to their native habitats all species threatened with extinction. Other divisions supervise education and recreation programs and monitor the environment.

FISHER, species of marten (q.v.).

FISHER, Dorothy Canfield (1879–1958), American novelist, born Dorothea Frances Canfield in Lawrence, Kans., and educated at Ohio State and Columbia universities. While in Rome in 1911–12 she met the Italian educator Maria Montessori (q.v.) and later wrote *The Montessori Mother* (1913), one of the first books in English on the Montessori system of education. During World War I Mrs. Fisher spent three years in France doing war work. She wrote extensively on education, and her *Why Stop Learning?* (1927) was one of the first popular works in the United States on adult education. She also wrote many novels, including *The Squirrel Cage* (1912), *The Bent Twig* (1915), *The Brimming Cup* (1921), *Her Son's Wife* (1926), *Nothing Ever Happens* (1940), and *Our Young Folks* (1943); the volumes of short stories *Four-Square* (1949) and *Harvest of Stories from a Half Century of Writing* (1956); and the historical work *Vermont Tradition* (1953).

FISHER, Irving (1867–1947), American economist, born in Saugerties, N.Y., and educated at Yale University. He was a member of the Yale faculty from 1890 to 1935 and from 1898 was professor of political economy. Fisher was the foremost exponent of the quantity theory of money. He was also concerned with the economic theories of interest and index numbers and contributed the concept of "the ideal index number". He was the founder of the Stable Money Association and published weekly wholesale price indices and market analyses, which found wide circulation in business journals. His economic theories were influential in

the government during the early period of the New Deal instituted under President Franklin Delano Roosevelt (q.v.). Fisher's interest in health and eugenics led him to found the American Eugenics Society in 1923. Among his works are *The Nature of Capital and Income* (1906), *The Purchasing Power of Money* (1911), *The Making of Index Numbers* (1922), *The Theory of Interest* (1930), and *Constructive Income Taxation* (1942).

FISHER, Saint John (1459–1535), English Christian bishop and martyr, born in Beverley, Yorkshire, and educated at the University of Cambridge. He remained at Cambridge, serving first as master of his college, Michaelhouse (later part of Trinity College), from 1497 to 1501; then as vice-chancellor of the university, from 1501 to 1504; and finally with a lifetime appointment as chancellor, beginning in 1504. Meanwhile, as chaplain of the powerful Lady Margaret Beaufort (q.v.), Countess of Richmond and Derby, Fisher became in 1503 the first Lady Margaret professor of divinity at Cambridge. One year later he was named bishop of Rochester. Fisher had a great progressive influence, promoting humanism (q.v.) and bringing the Dutch scholar Desiderius Erasmus (q.v.) to Cambridge to teach. As a churchman, however, Fisher strongly opposed and wrote treatises against the Reformation (q.v.), especially the doctrines of the German religious reformer Martin Luther (q.v.). In 1527 he protested the plan of Henry VIII (q.v.), King of England, to divorce Catherine of Aragón (q.v.), to whom Fisher was confessor. In 1534, when he and the English statesman Sir Thomas More (q.v.) refused to take the oath of the new act of succession, they were imprisoned in the Tower of London (q.v.). In May,

FISHER, JOHN ARBUTHNOT

1535, Pope Paul III (see under PAUL) made Fisher a cardinal. One month later, the new cardinal was brought to trial, accused of the treasonous act of refusing to accept Henry VIII as head of the church. He was beheaded on June 25. Fisher was canonized by Pope Pius XI (see under PIUS) in 1935. His feast day, which he shares with Saint Thomas More (q.v.), is June 22.

FISHER, John Arbuthnot, 1st Baron Fisher of Kilverstone (1841–1920), British naval officer, born in Ramboda, Ceylon. He entered the navy at the age of thirteen, served in the Baltic during the Crimean War, and later in China at the capture of Canton in 1859. In 1860 he became a lieutenant. He specialized in gunnery, and as captain of the *Inflexible* in 1882, he took part in the bombardment of Alexandria, Egypt, in the summer of that year. He became a rear admiral in 1890 and held a succession of high posts in the navy and the admiralty including those of lord commissioner of the navy and comptroller of the navy from 1892 to 1897, and second sea lord of the admiralty in 1902. As first sea lord of the admiralty from 1903 to 1909, Fisher exercised great influence on naval development and reform. He aroused opposition, however, because of his economies in administration and was accused of using autocratic methods. He was created a peer in 1909 and resigned from the service early in 1910. He was recalled as first sea lord in October, 1914, at the beginning of World War I. The British victory at the Falkland Islands was due to his bold strategy. Fisher was also responsible for the policies of naval blockade and extensive mining operations during World War I. His disapproval of the Gallipoli and Dardanelles Campaign (q.v.) caused him to resign in 1915. He later served as chairman of the Inventions Board. Upon his death the British people mourned him as the greatest sailor since Admiral Horatio Nelson (q.v.). He was buried in Westminster Abbey. Fisher wrote two volumes of reminiscence, *Memories* and *Records*. Both were published in 1919.

FISHERIES, collective name for commercial fishing enterprises, particularly those of a single country or other geographical unit; also, the waters in which such fishing is conducted. Fishing includes the taking of crustaceans and mollusks as well as fish.

Major Fishery Locations. The most important oceanic fisheries are in waters less than 200 fathoms in depth. In Europe they include the Baltic Sea, the North Sea, parts of the Bay of Biscay, the Atlantic Ocean near Great Britain, and parts of the Mediterranean Sea. Fisheries off the

western shores of the North Atlantic include the Grand Banks (q.v.), the waters off Labrador, Newfoundland, Nova Scotia, and the eastern United States. Off the eastern coast of South America extensive fishing grounds occur southward from Rio de Janeiro in Brazil and from southern Argentina across to the Falkland Islands. Off western North America a belt of fishing grounds extends from Baja California to Alaska and from the Aleutian Islands westward to Siberia and northward to the Bering Strait and beyond. Western Pacific Ocean fishing areas include the East China Sea, the South China Sea, the Arafura Sea north of Australia, and the coastal waters of New Zealand. Indian Ocean fisheries include the Timor Sea, the Gulf of Siam, the Bay of Bengal, and areas off the Cape of Good Hope. Freshwater fisheries occur in large lakes and rivers throughout the world.

Methods of Fishing. Commercial fishermen in general rely on very different techniques from those of the sport fishermen; see FISHING. The majority of fisheries employ nets designed to gather a large catch of fish in a single sweep.

One type of fishnet is the seine, a long, curtainlike net held vertical in the water by weights at the lower edge and floats at the top. As the seine is dragged toward the shore or pier, all the fish in the intervening water are pulled along with it. A similar fish-impounding device, the purse seine, has a rope along its lower edge used to draw the bottom of the net together, as a bag would be closed with a drawstring. The purse seine is towed around a school of fish by a skiff. After the rope is tightened, the vessel is positioned alongside the net and the catch is taken aboard using a smaller net called a brail. Purse seines are used both in inshore and open-sea areas.

The gill net, also set vertically in the water, is made of a specially sized mesh that catches and ensnares fish as they attempt to swim through it. Gill nets are referred to as drift nets when allowed to drift with the tide or current and as set nets when used in a stationary position.

Among nets used to catch fish that are scattered across the ocean floor, as opposed to species that travel in schools, is the beam trawl, a long conical net, the mouth of which is held open by wooden beams. Beam trawls are dragged along the sea bottom by a fishing vessel, continuously scooping fish in their paths into the net. The most modern form of net is the otter trawl, similar in appearance to the beam trawl. A pair of vanes attached to the mouth of the netting are forced apart—or open—by water pressure as the trawl is towed.

Longlines are another type of gear commonly used in fisheries. Longlines may be set on the surface for fish such as tuna, or on the bottom for halibut, cod, and other bottom species. For bottom fishing the gear consists of a long, heavy fishline or rope that is attached to moored buoys at the ends and to free buoys at intervals along its length. From this line—which is occasionally several miles long—hang auxiliary lines with baited hooks. The longline with its catch is hauled aboard the vessel by means of winches. In surface fishing the gear is usually allowed to drift freely until the entire catch is hauled into the boat.

In rivers and estuaries, particularly where fish migrate into fresh water to spawn, various forms of traps are used. The pound net involves a system of netting that is staked vertically in the water and is designed to funnel, or direct, the fish into an enclosure from which they cannot escape; pound nets are used to trap fish along their route of migration. Box traps made of slats of wood are used to catch lobsters. Crabs are caught in wire box traps. Many crabs, however, are taken in trawls and by tangle nets.

Pacific tuna are caught by large purse seines

Fishermen check the soundness of their weirs in a waterway at Saint John, New Brunswick, Canada. NFB



and longlines. Swordfish and other large species are also usually taken by longlines but may also be hunted in small motorboats and harpooned individually.

Oysters are harvested with dredges, or in some areas they are scooped off the bottom by men in boats using long-handled tongs. Clams are dug from the mud at low tide by means of long-tined rakes. Surf clams and scallops are usually harvested with various types of power dredges.

For the methods of catching seals and whales, see SEAL; WHALING.

United States Fisheries. The most productive fisheries are those of Alaska, California, Louisiana, and Texas. In 1973 their combined catches amounted to 2,259,000,000 lb., valued at \$454,000,000. The total catch for the U.S. in that year was 4,732,000,000 lb., including 3,825,000,000 lb. of fish and 907,000,000 lb. of shellfish; the corresponding values were: for the total, \$907,000,000; fish alone, \$452,000,000; and shellfish, \$455,000,000.

Important U.S. fisheries are also found off Massachusetts, Maine, Virginia, Maryland, New York, New Jersey, and North Carolina on the Atlantic Coast; Florida on the Gulf Coast; and Oregon and Washington on the Pacific Coast. On the Great Lakes, the fisheries of Lake Michigan rank highest in both the size and the value of catch.

The chief varieties of fish and shellfish caught in the U.S. (in terms of value of catch) are shrimp, Pacific salmon, tuna, crabs, menhaden, northern lobsters, oysters, clams, and flounder. About 30 percent of the annual catch is sold fresh or in frozen form, and another 30 percent is canned. The remainder, except for the 1 or 2 percent that is cured, is used for bait, fertilizer, or in other nonfood applications.

Canadian Fisheries. Commercial fishing is the oldest primary industry in Canada. In the decade from 1960 to 1970 it provided about 1,000,000 metric tons of fish a year and contributed about \$500,000,000 annually to the economy. More recently, however, fishing on the Atlantic coast decreased as stocks of cod, haddock, herring, and lobster were depleted. On the Pacific coast, salmon fishing improved in the same period, but halibut stocks dropped. The central and northern lakes continued to produce whitefish and some other freshwater species in commercial quantities. Overall income increased because of higher prices on the international market.

Less commercially valuable yet significant in catch, were, in the Atlantic fisheries, redfish,

FISHERS ISLAND

small flatfishes, oysters, and scallops. On the Pacific coast, herring fisheries were closed to fishing in the late 1960's, except for catches intended for human consumption; by the early 1970's, stocks were recovering. The interior freshwater lakes also yield appreciable numbers of a variety of fish such as perch, pickerel, trout, and pike.

Fishing is a major source of income in New Brunswick, Nova Scotia, Québec, and British Columbia.

See articles on most of the fish mentioned.

FISHERS ISLAND, island of New York State, in Suffolk Co., at the entrance of Long Island Sound, 8 miles S.E. of New London, Conn., and 14 miles N.E. of the eastern end of Long Island. Largely a summer resort area, Fishers Island forms part of the town of Southold. It is served by ferry from New London. Vegetation on the island is sparse, and there are several freshwater lakes. A United States Coast Guard station is located here. Area, about 4000 acres; pop. (permanent) about 400.

FISH HAWK. See OSPREY.

FISHING, in its broadest sense, the capture of fish by any means, including traps, nets, poisons, spears, explosives, or baited hooks. The term is, however, usually confined to angling, the sport of catching fish by means of baited hooks or artificial lures equipped with hooks. For methods of commercial fishing, see FISHERIES.

Fishing as a means of obtaining food undoubtedly was practiced as early as the Stone Age, and it is probable that before the development of crude fishhooks of bone, fish were caught by means of a gorge, an object such as a straight piece of bone with a line tied to its center. A fish could swallow the gorge easily but could not disengage it. Similar devices were later used by the ancient Greeks and were probably employed in other parts of the world during the same period. The Greeks also used hooks and fishing rods.

Fishing probably began to be regarded as a sport at about the same time, and was well established as a sport by the Roman era. In the Middle Ages, men fished both for food and for sport, and fishponds were a common adjunct of monasteries. After the publication (1653) of *The Compleat Angler* by the English essayist and poet Izaak Walton (q.v.), fishermen began to regard their pastime as both an art and a science. Many fishermen have since made exhaustive studies not only of fish and their habits, but also of the insect life on which they feed. To improve fishing as a sport, fishermen have endeavored to make artificial lures more realistic and

to improve various other items of their tackle. Ways have been devised to propagate game fish artificially for planting in lakes and streams. Modern anglers have been in the forefront of the movement to eliminate water pollution.

Fishing Tackle. The equipment used in angling is known collectively as fishing tackle and includes baits and lures used to attract the fish; lines and leaders, by which the fish are played, or brought to boat or shore; rods, which are employed in casting the bait or lure; and reels, on which the lines are spooled.

All baits are natural food substances. Among the great variety of baits employed to attract fish to the hook of the angler are worms, insects, small fish, fish eggs, frogs, crayfish, shrimp, crabs, strips of fish flesh and pork rind, and pastes and doughs of various composition. Lures are generally replicas of the animals on which fish feed. In many cases, however, they bear little actual resemblance to those animals but are effective because their action in the water resembles the action of the particular animal.

An important category of lures is artificial flies, which consist of hooks wound or tied with thread, yarn, hair, and other materials to resemble natural insects. Dry flies are designed to simulate insects floating on the surface of the water, and wet flies imitate the insect when submerged. Special types of flies include nymphs, which resemble insect larvae, and streamers and bucktails, which are tied with long bodies of hair and feathers and are drawn through the water to resemble the activities of minnows or other small underwater life forms. Plugs have wooden or plastic bodies, to which are attached one or more hooks, and are often colored to resemble fish or frogs. Spoons are spoon-shaped pieces of polished metal that wobble and reflect light as they are drawn through the water, thus simulating a swimming fish.

Spinners are lures with small, spinning blades and are attached to or above the shank of the fishhook, where they turn like propellers. Spinners are often used together with flies, live bait, or other lures.

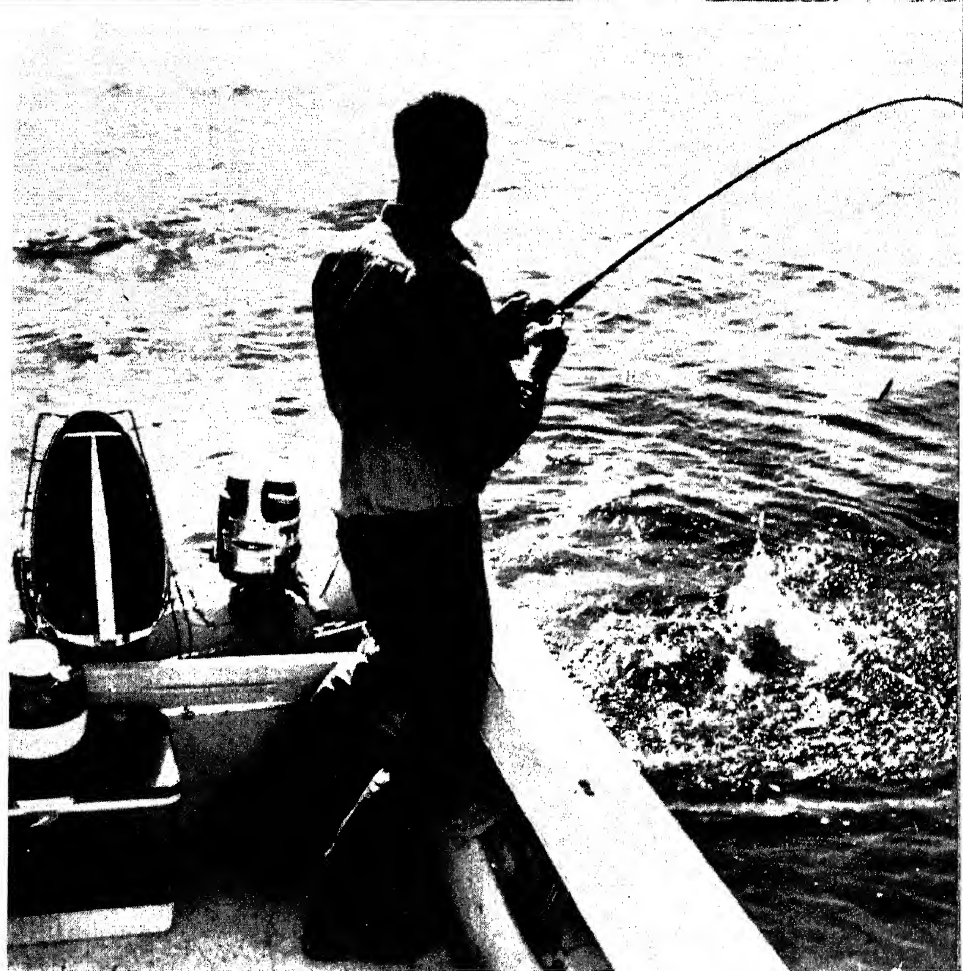
Fishhooks vary in size and style. In general, a fishhook has a straight shank with an eye at one end, to which the line or leader is tied. The other end of the shank is curved up to a sharp point, which is usually barbed to prevent the hook from escaping the mouth of the hooked fish.

Expert anglers sometimes employ barbless hooks, which can be removed without harming



Many methods are used in fishing for sport and food. Above: Smelt, a popular food fish, is caught in the surf with basket nets. Right: A flexible rod and strong line are needed to catch king salmon, prized both as food and game fish.

Washington State
Dept. of Commerce



FISHING

a fish so that it may be released after capture. Gang hooks, consisting of two or more points on a single shank, are often used on plugs. Fish-hooks range in overall length from less than a quarter of an inch to almost a foot.

In some kinds of fishing, the line is tied directly to the hook. In other cases a transparent leader is used between the hook or lure and the line. Thin leaders, made of nylon, are frequently employed for fishing in clear water, since they are less visible to the fish. When angling for fish that have sharp teeth, it is usual to use a leader of wire or very thick nylon so that the fish cannot bite through it.

Fishing lines are generally made of nylon or other synthetic materials. Both monofilament, or single-strand, and woven nylon lines are widely used. Fly lines are impregnated or coated with various plastics to add weight and cause them to float or sink.

Trolling lines are generally made of nylon, dacron, or metal. Nylon lines are either monofilament or woven. Some lines are classified according to breaking strength, others by weight and diameter. Those in common use range from a breaking strength of about 2 lb. to more than 100 lb. In most cases the breaking strength of a line is greater than the weight of the fish caught.

Many anglers use a landing net to lift their catch from the water after the fish has been hooked and played. Sharp, hook-shaped gaffs are sometimes employed to land large fish.

The fishing rod has a threefold purpose. It not only enables the angler to cast his lure or bait farther than he could throw it by hand, but permits him to control his line more easily than could be done by hand. The rod also furnishes a springing resistance to the struggles of the fish, enabling the angler to play and land fish on lighter lines and leaders.

The simplest form of fishing rod is a long pole, usually a bamboo or cane stalk, with the line tied to its thinner end. Rods used for casting flies or lures rely upon resiliency to gain distance in the cast. Such rods are commonly made of tubular fiber glass or of six strips of cane cemented together. The rods, usually made in two or more sections and tapered from butt to tip, are equipped with a number of metal guides. The line passes through these guides, which hold it close to the rod. A hand grip, made of cork or other material, is usually provided near the butt end.

Rods for fly casting are usually made in lengths of 6 to 10 ft. Those used for spinning and casting are usually shorter, ranging from 4

to about 8 ft. and are less resilient. Rods used for trolling and for some forms of deep-sea fishing are often quite heavy because of the weight and strength of the fish involved, and because heavy baits or lures are used.

Fishing reels, of three major types, are usually mounted on the rod near the grip. Casting reels consist of an enclosing frame, the revolving spool on which the line is wound, and a handle for turning the spool. The reel is geared so that one turn of the handle rotates the spool four times.

Fly reels also have a frame and a revolving spool on which the line is wound, but most are single action, that is, the handle is attached directly to the spool. Some fly reels are automatic, the spool turning at the touch of a lever; automatic reels are powered by windup springs.

Spinning reels have a fixed, nonturning spool, with the axis set parallel to the rod so that the line flows from it freely when the cast is made. A curved carrier revolves around the outside of the spool as the reel handle is turned, winding the line on the spool. Some spinning reels have an open face or frame, and others are covered, with the line running through a small hole in the cover and controlled by a button or lever when casting.

Types of Fishing. The simplest fishing technique is that of still-fishing, in which the angler lowers his baited hook into the water and leaves it there until a fish takes it. A float or bobber, of cork, wood, or plastic, is usually attached to the line so that the bait will be held at the proper depth below the surface of the water. If the bait has a tendency to float, a small lead weight called a sinker is attached to the line at or near the hook. When the angler lowers his bait so that it rests deep in the water near the bottom, he is said to be bottom fishing. A variation of still-fishing is the use of a trot line, a line with a series of baited hooks stretched across a stream or held out from one shore by an anchored float at the end.

In spinning or bait casting, an artificial lure is cast from the shore or from a boat and is retrieved, with the angler making repeated casts to place his bait in various parts of a large area of water. Lures used in this type of fishing are comparatively heavy and will fly long distances when properly cast with a rod. In flycasting, on the other hand, the lures have almost no weight, and long casts are made by working out a length of line while the rod is whipped backward and forward. Because the weight of the line can help give distance to the cast, fly lines are comparatively heavy.

Trolling is a form of fishing in which the angler lets his lure trail through the water behind a slowly moving boat. When the lure is fished at great depths, it is usual to employ a trolling line of the heavier copper or nickel-silver wire, rather than an ordinary line. In deep-sea sport fishing, trolling is the usual method practiced, and chum, or chopped-up fish, is often spread on the water to attract game fish to the bait.

Many variations of these basic methods of fishing are employed to suit local conditions and the type of fish sought. Ice fishing, for example, is a form of still-fishing in which the fisherman drops his bait in a hole chopped through the ice of a frozen body of water. In jug fishing, a common form of fishing in the Mississippi R. valley, lines with baited hooks are tied to empty jugs which float slowly downstream and are later retrieved with the catch. A sport akin to angling is spear fishing, popular in tropical and semitropical waters. The spear fisherman wears a water-tight mask or goggles that enables him to see underwater, and hunts his quarry by diving and spearing the fish in its own environment.

Game Fish. From the point of view of the sportsman, the gameness and ability of a fish to fight against the angler and his tackle are of more importance than its edibility. For this reason a number of species are highly regarded as

game fish, although they are virtually inedible. The salmon, however, an important freshwater game fish, is excellent as food. Various species of trout, which belong to the same family as the salmon, are also strong fighters and are tasty when cooked. The most popular game fishes in the United States are the basses, which are known by a number of local names; see **BASS**. They are related to the sunfishes (see **SUNFISH**), which are also fished for extensively. Other popular freshwater game fish in the U.S. include the pike, pickerel, and walleye (see **PIKE**), and the catfish and muskellunge (qq.v.).

Game fish living in saltwater can be divided into two groups: the species living and feeding near the shore, and those which are found in deep water. Among the coastal species sought by American anglers are striped bass, channel bass, pollack, porgie, blackfish, halibut, bonefish, and flounder. Deep sea game fish, most of which are of large size, include tuna, swordfish, sailfish, marlin, tarpon, and various types of shark.

See also **WHALING**.

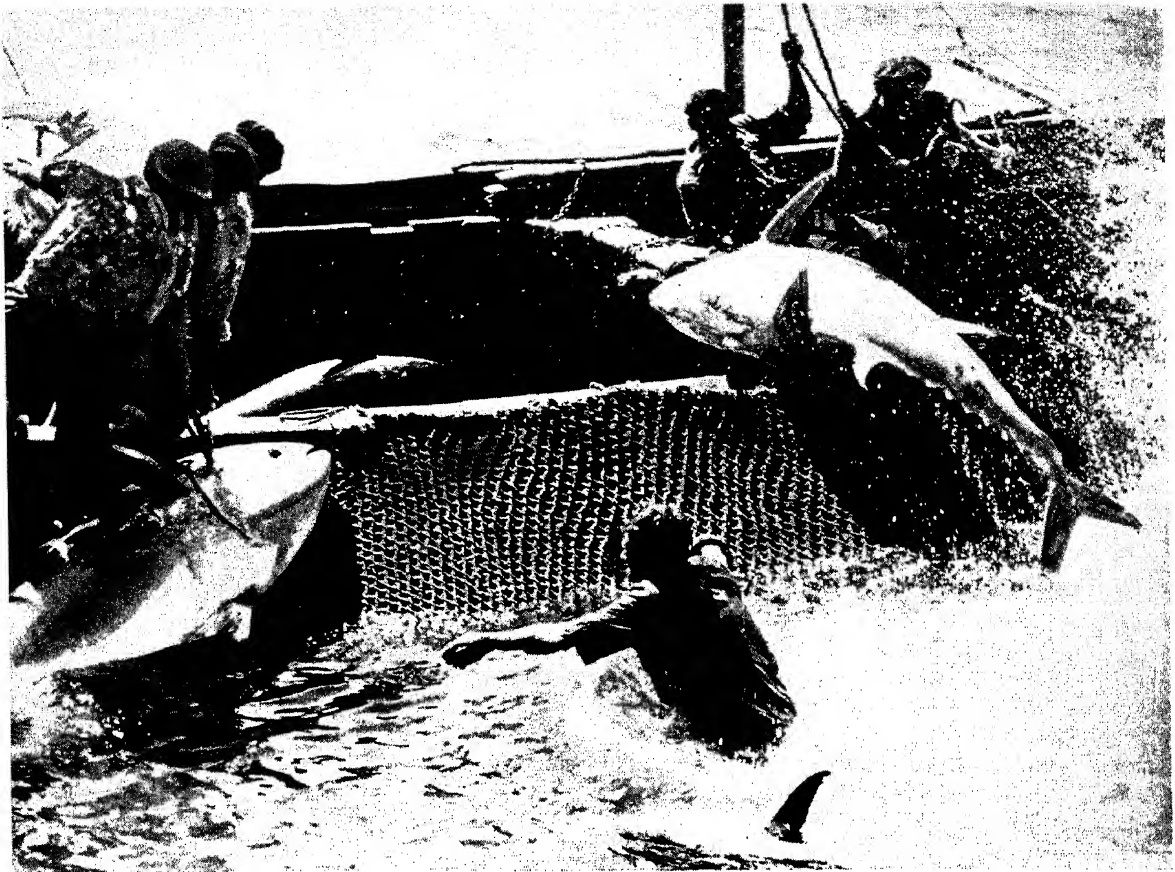
FISHING LAWS. See **GAME AND GAME LAWS**.

FISHING VESSELS, craft employed in the commercial fisheries. In general, fishing vessels are

Shrimp trawlers of both wooden and steel construction are usually diesel-powered, such as the boats shown below at anchor in Port Aransas, Texas. Texas Highway Dept.



FISHING VESSELS



The crewmen of a Portuguese trawler lift tuna into the fish well. The smack tows a net alongside, which, when raised, permits crewmen to assist in hoisting big fish from outside the craft.

UPI

small, usually under 60 ft. in length. The fishing fleets of nations with well-developed fisheries often include much larger vessels, but small boats, propelled by oars, sail, or motors, represent the largest single investment in the fishing industries of most nations.

Although the development of fishing vessels began in ancient times, little was recorded about the characteristics of such boats until the 18th and 19th centuries. At that time drawings and pictures of fishing vessels became common, particularly in northern Europe and North America, where the fisheries were important in the national economies. In the same period plans of fishing boats were made, and many of these have been preserved. In the last quarter of the 19th century and during the 20th century rising interest in marine archeology and in technological history led to the recording of the designs of many types of fishing craft all over the world. In recent years international organizations, such as the Food and Agriculture Organization of the United Nations (q.v.), have carried on extensive

studies of fishing-boat design for the benefit of nations attempting to develop their fisheries.

Early American Types. The sailing and rowing fishing boats developed in most parts of the world appear to have been the result of prolonged experimentation; see **MOTORBOAT**; **SAILING**. Such craft are usually marked by practical and excellent hull design. A great variety of types evolved, each suitable for the geographical, climatic, or economic conditions prevailing in the area of its use. For example, more than 200 distinct types of fishing boats were developed in North America. Some of these were open rowing and sailing craft, and many were large. Some were designed to work off open beaches. Others were made for use in shoal or stormy, dangerous waters or for other specific purposes.

The intensive development of sailing fishing craft in the 18th and 19th centuries produced in North America many notable types of vessels. A large number of highly individualistic types were also developed in the maritime countries abroad. See **BOAT**.

It is not known when and where fishing craft were first equipped with fish wells, the holds or tanks containing sufficient water to keep the

catch alive. In the late-18th century the well appears to have been limited to a few craft in Scandinavia, the Netherlands, and Great Britain. In the 19th century the well smack, or smack boat, which was equipped with a well, became popular in the United States. It first appeared in New England as a schooner. By 1850 the well was used in various types of craft in the north, and it spread into southern waters with the rise there of commercial fisheries after the American Civil War. The well remained common in American fresh-fishing boats until the practice of icing the fish was introduced in New England in the late 1830's.

The most popular early sailing craft used in the American fisheries carried a spritsail rig. In the 1880's the gaff-mainsail and large-single-jib sloop replaced some of the spritsail craft. Another popular rig employed two masts without jib or headsail, with the foresail somewhat larger than the mainsail. The leg-of-mutton sail was used to a limited degree in Long Island Sound, in the Carolina sounds, on Chesapeake Bay, and on the Florida coast.

Because many early American fishing boats had shallow-draft hulls, the use of the centerboard was widespread. Some of the centerboard models were replaced late in the 19th century by keel hull forms, of which the Friendship sloop of Maine is an example. Centerboard fishing schooners were built in New England, but these were relatively rare. The schooners

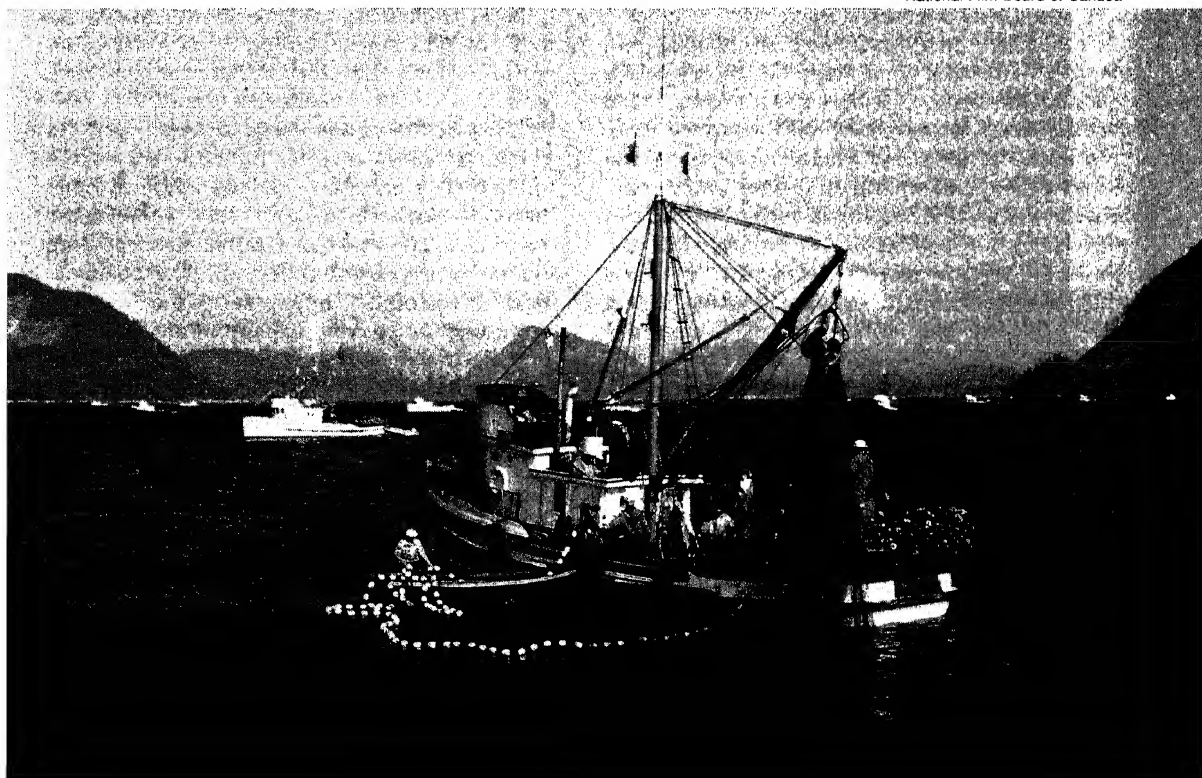
used in the Long Island, New Jersey, and Chesapeake Bay oyster fisheries were usually centerboard craft. Keel hull forms predominated in offshore and exposed-water fisheries such as the Grand Banks (q.v.) fisheries, off Newfoundland.

Early European Types. The sailing craft used in the fisheries of Europe also varied a great deal in model and rig. Although many European fishing craft were swift sailers, the emphasis on speed never became as great as in the U.S. in the 19th century. The lugsail and lateen-sail rig was relatively common, the lateen in the Mediterranean region and the lug on the northern European and British coasts. The gaff-rigged ketch and gaff-rigged cutter were also employed extensively in the fisheries of northern Europe. The spritsail was used on some Dutch, Scandinavian, Greek, and Turkish fishing craft. Most of the European sailing fishing vessels were of keel hull form. The centerboard was employed very rarely. Lee boards were used extensively on the Belgian and Dutch coasts, where shoal-craft fishing boats were required because of the shallow water.

Asian Types. Early Asian fishing boats varied greatly. The Chinese fishermen developed a large variety of sculling, rowing, and sailing craft ranging from small open skiffs, or sampans to

The crew of a salmon seiner lowers the net into the waters of Johnstone Strait off Vancouver Island, Canada.

National Film Board of Canada



FISHING VESSELS

large decked craft, or junks, 70 ft. or more in overall length. Most of these craft were rigged with lugsails although a few employed a type of spritsail. As a rule the fishing junks and sampans sailed swiftly and were highly seaworthy. The Japanese used sailing and rowing sampans with rather primitive rigs, usually a small lugsail or square sail. After 1875, however, some schooner-rigged sampans appeared, and schooners of the American type were built for offshore fisheries.

In southern Asia the outriggered, dugout canoe, as well as various types of planked boats, were employed in the inshore fisheries, see CANOE. The Malays developed a very swift, double-ended sailing canoe, the prau, and the Indians and Arabs on the Persian Gulf produced swift-sailing, decked fishing craft, usually with lateen or very similar rig.

Early Power Fishing Vessels. Steam was not used extensively for the propulsion of small fishing boats. The weight and cost of engine and boiler made such craft generally uneconomical in North America and Europe. Steam power was employed in large fishing vessels, however, particularly in the European trawlers and drift-net fishing vessels of northern Europe. Steam fishing vessels and steam auxiliary schooners were built in the U.S. after the Civil War, but there were few fisheries in which such vessels were profitable. The menhaden fisheries and others of the U.S. employed steamers from about 1886 until the introduction of the gasoline and diesel engines.

Soon after reliable gasoline engines appeared, frequent attempts were made to employ motor craft in the inshore fisheries. As early as 1908 fishing boats powered by such engines were common on the New England coast, on the Great Lakes, and on the southern and Pacific coasts of the U.S. The replacement of the old sailing types of fishing boats by motor craft was well advanced in North America by 1914, and the movement was accelerated during World War I. The replacement of old sailing types became quite rapid in Europe after the war.

The early power fishing vessels were usually conversions of old sailing models, sometimes with all or at least part of the sailing rig retained. After more powerful engines became available at relatively low cost it was found that the sailing types were not always well suited to the use of such engines. Some types were modified as a result, but usually new models were developed.

Modern Types. Types of modern fishing boats are less numerous than the old sailing models, but recent years have seen a revolution in the

design, mechanization, and automation of hulls and gear. Today countries such as Japan and the Soviet Union are capable of placing huge, self-contained fleets on fishing grounds far from their own shores. Giant mother ships with hospitals, repair shops, fuel tanks, libraries, and other necessities and comforts oversee swarms of smaller trawlers. Some fleets are made up of large freezer trawlers or factory trawlers that catch, process, and store the fish for weeks at sea and then land their catch hundreds or thousands of miles from the fishing grounds in prime condition.

European and Asian countries have led in the development of modern fishing vessels, typified by the stern-ramp trawler and the factory ship. The appearance of their fleets off both the Atlantic and Pacific coasts of the U.S. has caused great concern among fishermen but has been beneficial in that it has spurred outdated segments of the American fishing industry into developing vessels capable of competing with the encroaching foreign fleets.

American fishing craft are usually made of wood; however, there is a growing tendency to use other materials, such as steel, aluminum, and fiberglass reinforced plastic (F.R.P.). The majority of the larger vessels, such as offshore trawlers, menhaden boats, shrimp trawlers, tuna seiners, and king-crab boats are of steel construction. Today even some of the smallest commercial fishing craft, for example, the lobster boats of New England and the gill-netters and salmon trollers of the Pacific Northwest, are built of F.R.P. or aluminum in an effort to increase efficiency and reduce maintenance costs.

Most of the new vessels are designed for a particular fishing method, but some are laid out so that they can be converted easily to other fisheries. Such vessels are called combination boats and offer their owners the chance to keep operating throughout the year. The combination boat is especially popular in the American Northwest where various seasons are set by law and a vessel must operate in several fisheries in order to pay its way.

TYPES OF VESSELS. Although a great variety of species is hunted by fishermen, a few basic types of vessels are used. Thus, small, gasoline-powered boats ranging from 20 to 40 ft. in length and rigged for trap, net, or line fishing, are used in the New England lobster fisheries, in the finfish and shellfish fisheries of the Mid-Atlantic and Gulf coasts, and in the salmon fisheries of the Northwest. The use of hydraulic machinery and electronic navigation and

fish-finding devices on these boats is taking some of the drudgery out of their operation.

Draggers or trawlers, powered with diesel engines and from 40 ft. in length to as much as 300 ft. in the latest ships, tow nets, called trawls, for fish, or dredges for shellfish. Conventional trawlers are side trawlers; that is, they tow their nets from one side of the vessel. Most new ships, however, are stern trawlers and tow and haul over a stern ramp. The latter are considered more efficient. Shrimp trawlers tow their nets from booms swung out on each side of the boat. In all cases, powerful winches wind in the cables leading to the nets, which in turn are held open by hydrofoils, called trawl boards or doors.

Seiners carry giant nets with surface floats on one edge and weights on the other. The nets are towed around a school of fish by a small net boat while one end of the net remains fastened to the mother vessel. The bottom of the net is then pursed, or closed, and the net is tightened by a powerblock aboard the seiner. The catch, consisting of tiny anchovies, herring, salmon, or big tuna, depending upon the fishery, is then bailed or pumped aboard the seiner. American tuna seiners are among the finest fishing vessels in the world, being fast, efficient, long-ranging, and handsome in appearance.

Deepsea longliners and crab vessels are similar in that they are big, able boats ranging from 50 ft. to more than 100 ft. in length. The longliner operates by setting long lines thousands of feet in length, anchored and buoyed at each end, with shorter lines and baited hooks tied to the main lines. Bottomfish (cod, haddock, halibut) and pelagic fish (swordfish, tuna, sharks) are caught on longlines. Crab vessels drop large, baited, steel-and-wire traps overboard and buoy these so they can be found again. Both longliners and crab vessels retrieve their fishing gear with hydraulic haulers of various types.

Other American fishing vessels are peculiar to their areas. Thus, the odd-looking fishing tug of the Great Lakes, which is all house and no outside deck, offers protection from the weather to its crews. Maryland law limits oyster dredging to sail power, so skipjacks, V-bottomed sloops from 36 to 55 ft. in length, are used on Chesapeake Bay.

The trend today is to comfort and efficiency on fishing vessels throughout the world, needs brought about by the competition of well-paying shoreside jobs and the high cost of running a fishing boat. The need to modernize is forcing fishermen to look beyond traditional types of fishing vessels and is prompting naval

architects to design more adaptable and profitable craft. The growing danger is that soon fishing vessels will virtually be able to sweep the bottom clean, a fact that is already making the modern high-seas fishing boat a political tool as well as an effective machine for harvesting food from the sea.

FISH LOUSE, common name of any of a group of crustaceans belonging to the subclass Copepoda; see CRUSTACEA. Copepods generally occur as external parasites on freshwater and saltwater fishes. The largest species reach a length of nearly $\frac{1}{2}$ in. Certain fish lice are free-swimming nonparasites. The parasitic fish lice are of interest to zoologists because in the adult stages they often exhibit varying degrees of degeneration. Sometimes the females alone are parasitic or become parasitic only when about to bear eggs. One species, *Anchorella uncinata*, attaches itself to the fins and gills of codfish. Another species, *Lernaea elongata*, attaches itself to the eyes of dogfish. Some species, such as *Panella*, become internal parasites. *Argulus foliaceus* is a common species parasitic on carp, perch, pike, and frequently trout. Certain fish lice have been found on some amphibians.

FISH OF PARADISE. See PARADISE FISH.

FISK, James (1834–72), American financier, born in Bennington, Vt. He began as a peddler in New England and worked his way upward to a partnership in a Boston dry-goods firm. During the American Civil War he made a fortune on government contracts and by running cotton through the blockade. In 1866, with the aid of the American financier Daniel Drew (1797–1879), he founded the brokerage house of Fisk and Belden in New York City. He participated in the successful operation carried out by Drew and the Jay Gould (q.v.) interests to deprive Cornelius Vanderbilt, the founder of the Vanderbilt (q.v.) family fortune, of his holdings in the Erie Railroad. The conclusion of this financial battle saw Fisk and Gould in control of the railroad as vice-president and president, respectively. Together they carried out various financial and speculative operations which involved the bribery of government officials on city, State, and national levels. Their projects culminated in the so-called gold conspiracy of 1868 and 1869, in which their success in driving up the price of gold resulted in a countrywide depression. Their attempt to corner the market in gold resulted in the financial panic of the famous Black Friday (q.v.) of Sept. 24, 1869. They failed only because President Ulysses Simpson Grant (q.v.) released government gold for sale. Three years later Fisk was shot in a quarrel.

FISKE, John (1842–1901), American philosopher and historian, born Edmund Fisk Green in Hartford, Conn., and educated at Harvard University. He adopted the name of John Fiske about 1860. In 1864 he was admitted to the bar, but soon gave up his legal pursuits and began writing for periodicals. In 1869 at Harvard he gave a series of lectures on Positivism (q.v.), and the following year he was appointed history tutor at the university. Two years afterward he became assistant librarian, a post which he held until 1879. In 1881 he was named to a lectureship at Washington University, Saint Louis, Mo., becoming nonresident professor of American history in 1884. He later lectured throughout the United States and in London.

His writings on philosophy were responsible for spreading in the U.S. the ideas of the British philosopher Herbert Spencer and the originator of the theory of evolution Charles Darwin (qq.v.). Fiske claimed as his contribution to the doctrine of evolution his detection of the part played by the longer period of infancy in man than in animals. His works include *Darwinism and Other Essays* (1879), *Excursions of an Evolutionist* (1883), *The Destiny of Man, Viewed in the Light of His Origin* (1884), and *The Idea of God as Affected by Modern Knowledge* (1885).

During his lifetime he was best known as a historian. His numerous works in that field comprise a nearly complete history of America in colonial times. These books, however, have now been superseded by the more detailed and careful researches of modern historians.

FISKE, Minnie Maddern (1865–1932), American actress, born Minnie Maddern Davey in New Orleans, La., the daughter of a theatrical manager and an actress. Her acting career was divided into two significant periods. The first began with her appearance on the stage at the age of three and lasted until her temporary retirement from the stage in 1890, after her marriage to the playwright and dramatic critic Harrison Grey Fiske (1861–1916). During this period she played, under the name of Minnie Maddern, in popular plays usually of little permanent interest. In the second period she became well known as a serious actress, especially for her roles in the works of the Norwegian dramatist Henrik Ibsen (q.v.). Among the Ibsen plays in which she played the heroine are *A Doll's House* (1894), *Rosmersholm* and *The Pillars of Society* (1907–10), and *Ghosts* (1927). Her performances in these plays, which were produced by her husband, did much to make the works of Ibsen popular in the United States. She is considered one of the best actresses of her time.

FISK UNIVERSITY, private coeducational institution of higher learning for Negroes, located in Nashville, Tenn., and founded in 1866. The university was established, largely through the efforts of the American prohibitionist Clinton Bowen Fisk (1828–90), by the American Missionary Association of New York, and the Western Freedmen's Aid Commission of Cincinnati (see FREEDMEN'S BUREAU) as the Fisk School for Freedmen; it was chartered as Fisk University in 1867. The institution offers courses leading to the degrees of bachelor and master in liberal arts and sciences. In 1968 the university library housed more than 157,000 bound volumes. In 1968 the enrollment was 1161, the faculty numbered 120, and the endowment was about \$9,109,000.

The institution is known for the Fisk Jubilee Singers, a group formed from among the student body in 1871 for the purpose of raising funds for the university. On its first appearance the group raised \$150,000 in three months, and the organization has since toured the United States and Europe with great success, spreading interest in Negro spirituals.

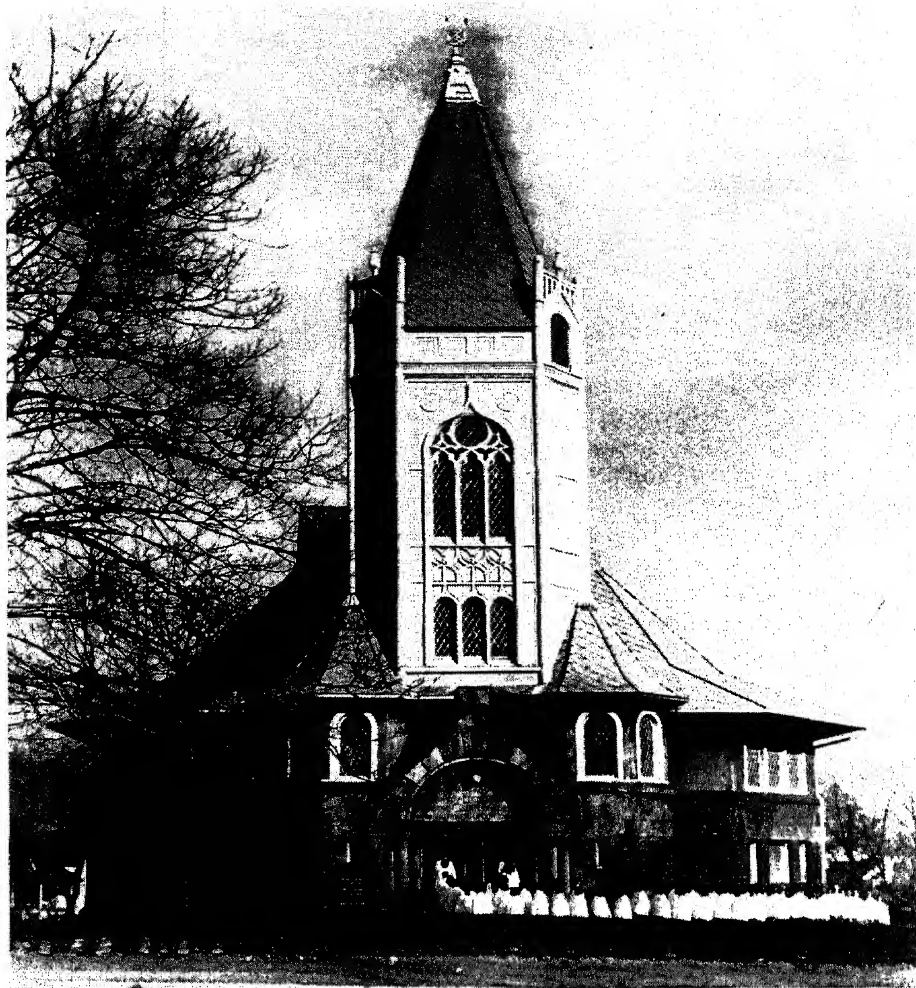
FISSION, in biology, type of asexual reproduction, characterized by division of the body into two or more parts, each of which develops into a complete individual. Binary fission may be identical with cell division (see CELL: *Cell Division*), or it may involve a reorganization of the protoplasm and a building up of new cellular structures. The latter type of binary fission may be transverse (occur across the width of the organism), as in the paramecium, a protozoan, or it may be longitudinal (occur along the length of the organism), as in the euglena, a colonial flagellate. Certain cysts also reproduce by binary fission. Multiple fission may consist of several successive binary fissions within a sheath, as in Sporozoa, a class of parasitic protozoans. In other cases of multiple fission the nucleus may divide repeatedly, and the cytoplasm subsequently divide into as many parts as there are nuclei, as in the malarial protozoan. Fission is common among certain unicellular organisms, but is rare in multicellular organisms, as it requires a regeneration of specialized parts in each of the daughter individuals. Planarians and certain annelids sometimes reproduce in this way.

FISSION, NUCLEAR. See NUCLEAR ENERGY: *Nuclear Fission*; NUCLEAR POWER; NUCLEAR WEAPONS.

FISTULA, abnormal, inflamed passage leading from one internal organ, canal, or cavity to another, or to the surface of the body. Fistulas may be acquired or congenital. Acquired fistulas

The internationally known Jubilee Singers are shown entering Fisk Memorial Chapel of Fisk University.

Fisk University



may be caused by an abscess, by injury, or by retention of a foreign body, resulting in inflammation or obstruction. Congenital fistulas are the result of some embryological defect. A fistula may transmit a secretion, such as pus, to both its external and internal openings. A blind fistula has only one opening, either external or internal.

Fistulas are usually named from the particular organ or region of the body affected. For example, salivary, bronchial, and biliary fistulas affect the salivary gland, the neck, and the gall bladder, respectively. Fistulas may also form between the urinary bladder and the rectum or the vagina. They also occur between the ureter and the vagina. The most common fistula affecting these organs, called vesicovaginal fistula, occurs between the bladder and the vagina and is usually the result of injuries sustained in difficult childbirth; see GYNECOLOGY. Congenital fistulas in the heart are responsible for many common forms of heart disease.

The secretion discharged from an external fistula may cause eczema, erythema, or ulceration of the skin adjacent to the opening. Fistulas are generally treated by cauterization followed either by surgical closure or excision. The American gynecologist James Marion Sims (1813–83) performed the first operation on a vesicovaginal fistula in the United States in 1845.

FITCH. See FUR; POLECAT.

FITCH, (William) Clyde (1865–1909), American playwright, born in Elmira, N.Y., and educated at Amherst College. Several of his plays were especially written for celebrated stars of his time. Among these are *Beau Brummel* (1890), for Richard Mansfield (q.v.); *Barbara Frietchie* (1899), for Julia Marlowe (q.v.); and *Her Great Match* (1905), for Maxine Elliott (1871–1940). Fitch's great versatility was displayed in the wide range of style and subject matter of his plays. In addition to those mentioned, his plays include *Nathan Hale* (1898); *The Climbers* (1901); *The Girl with the Green Eyes* (1902, re-

FITCHBURG

garded by many as his most significant work); *The Woman in the Case* (1905); and *The Truth* (1907). Fitch also wrote the novel *A Wave of Life*, and short stories and essays.

FITCHBURG, city of Massachusetts, and one of the two county seats of Worcester Co., on the N. fork of the Nashua R., 48 miles N.W. of Boston. It is an industrial center served by railroads and airlines. The principal industries in the city include the manufacture of paper, shoes, textiles, plastics, machinery, leather goods, and clothing. Fitchburg is the site of a State teachers' college founded in 1895. An art association in the city maintains a notable collection of 18th-century French prints; displayed in a historical museum in the city are exhibits on industrial inventions. Fitchburg, settled about 1730, was incorporated as a town in 1764 and chartered as a city in 1872. Pop. (1960) 43,021; (1970) 43,343.

FITZGERALD, Edward (1809–83), British poet and translator, born near Woodbridge, Suffolk, England, and educated at Trinity College, University of Cambridge. He is best known for his translation (1859) into English rhymed verse of the *Rubáiyát* by the Persian poet Omar Khayyám (q.v.). Earlier, under the guidance of his friend Edward Byles Cowell (1826–1903), later professor of Sanskrit at Cambridge, FitzGerald had become interested in Oriental studies. He had prepared in Miltonic blank verse a translation (published anonymously, 1856) of *Salaman and Absal* by the Persian poet Jami (q.v.).

In 1857 FitzGerald offered *Fraser's Magazine* a selection from his translation of the *Rubáiyát*, but the verses were rejected. He then gave them to his friend, the English bookseller and publisher Bernard Quaritch (1819–99), who in 1859 issued them anonymously. The booklet failed to sell and had been relegated to the "penny box" outside Quaritch's shop, when the British poet Dante Gabriel Rossetti (q.v.) came upon a copy and informed his friends, also British poets, Algernon Charles Swinburne (q.v.) and Richard Monckton Milnes (1809–85) of the find. As a result of the enthusiasm of the three poets, a second edition of the *Rubáiyát* appeared in 1868. The FitzGerald translation reached a popularity never achieved by any other translation of a secular Oriental poet into the English language.

Other works by FitzGerald include *Euphronor: A Dialogue on Youth* (1851) and *Readings from Crabbe* (1882). He also wrote English versions of the Greek drama *Agamemnon* (1865) by Aeschylus, as well as translations of two plays by Sophocles and of six dramas by the 17th-century Spanish dramatist Pedro Calderón de la Barca (qq.v.).

FITZGERALD, Ella (1918–), one of the best-loved jazz singers of her era, known for her renditions of ballads and novelty songs and for her ability in scat singing (singing meaningless syllables in order to use the voice as an instrument).

She was born April 25, 1918, in Newport News, Va., and spent her early years in a New York City orphanage. At the age of sixteen she was discovered by the bandleader Chick Webb when he heard her sing in a Harlem talent show. From 1934 until 1939 she sang with Webb's band, becoming one of its most valued assets and directing it for a time after his death in 1939. She subsequently specialized in solo nightclub acts. In the mid-1940's she began working with the impresario Norman Granz, touring in both Europe and Asia and performing in his Jazz at the Philharmonic concerts. Noteworthy among her recordings under his sponsorship was a series of albums featuring songs by composers such as George Gershwin, Cole Porter, Irving Berlin, and Duke Ellington. In 1955 she appeared in the film *Pete Kelly's Blues* and in 1958 with Ellington at Carnegie Hall in New York City. She has toured Europe frequently with the Oscar Peterson Trio and has appeared regularly at the Newport Jazz Festival. Her own compositions include "A-Tisket, A-Tasket", "Oh, But I Do", and "You Showed Me the Way". See JAZZ.

FITZGERALD, F(rancis) Scott (Key) (1896–1940), American writer of novels and short stories that epitomized the mood and manners of the 1920's—the Jazz Age—as he termed it.

Fitzgerald was born Sept. 24, 1896, in Saint Paul, Minn., and sent to local Catholic boarding schools. At Princeton University he mostly ignored formal study, instead receiving his education from such writers and critics as Edmund Wilson, who remained his lifelong friend. In 1917 he quit Princeton to take an army commission, and in training camps he revised the first draft of his novel *This Side of Paradise* (1920). While at a camp in Alabama, he fell in love with eighteen-year-old Zelda Sayre (1901–48), who, as the archetypal flapper, was to become as integral a part of Fitzgerald's fiction as he was.

This Side of Paradise, published in the spring of 1920, made Fitzgerald rich, or rich enough at least to marry his high-living Zelda. In this autobiographical novel the young, disillusioned postwar generation found mirrored their shattered dreams and empty, irresolute lives. His next novel, *The Beautiful and the Damned* (1922), a mood piece chronicling the anxieties and dissipations of a rich couple, proved some-



F. Scott Fitzgerald, about 1925

The Granger Collection

what less popular. His short stories, however, were in great demand. They paid for his and Zelda's partying and hotel-society life-style. Of his more than 150 stories, he chose 46 to appear in four books: *Flappers and Philosophers* (1920), *Tales of the Jazz Age* (1922), *All the Sad Young Men* (1926), and *Taps at Reveille* (1935).

In 1924 the Fitzgeralds left their Long Island home for the French Riviera, not to return permanently to the United States until 1931. In five months he completed *The Great Gatsby* (1925), a sensitive, satiric fable of the pursuit of success and the collapse of the American Dream. Although it is generally regarded as his masterpiece, *Gatsby* sold poorly, thus accelerating the disintegration of his personal life. Despite Zelda's slide into insanity and his into alcoholism, he continued to write, mostly for magazines. It was not until 1934 that his third novel appeared. *Tender Is the Night* was a thinly disguised, almost confessional story of his life with Zelda. Its poor reception led to his own breakdown, recorded in his essays collected by Edmund Wilson in *The Crack-Up* (1945).

Fitzgerald recovered sufficiently to become a screenwriter in Hollywood in 1937. That experience inspired his final and most mature novel, *The Last Tycoon* (1941). Although it remained unfinished at his death on Dec. 21, 1940, the book's brilliance prompted critics to reevaluate Fitzgerald's talent and eventually to recognize him as one of the finest American writers of the 20th century.

FITZJAMES, James. See BERWICK, DUKE OF, JAMES FITZJAMES.

FITZPATRICK, Robert Daniel. See CARICATURE: *Caricature in America*.

FITZSIMMONS, Bob, in full ROBERT PROMETHEUS FITZSIMMONS (1862–1917), British-born prizefighter, born in Helston, Manchester, England, and taken as a child to New Zealand. He first fought in the United States in 1890. In 1891 he won the middleweight boxing championship of the world from the American prizefighter Jack "Nonpareil" Dempsey, who had been champion for seven years. In 1897 Fitzsimmons became world heavyweight champion by defeating the American prizefighter James J (ohn) Corbett (q.v.); he held this title until 1899, when he was himself defeated by another American prizefighter, James J. Jeffries (q.v.). From 1903 to 1905 he held the world light heavyweight title, and he did not retire from competition until 1914, when he was fifty-two years old and still capable of a remarkable defensive performance.

FIUME, Italian name of Rijeka (q.v.).

FIVE CIVILIZED TRIBES. See OKLAHOMA: *History*.

FIVE FORKS, BATTLE OF, decisive engagement of the Petersburg campaign of the American Civil War; see CIVIL WAR, THE AMERICAN. It was fought on April 1, 1865, at Five Forks, a locality on the White Oak road about 15 miles S.E. of Dinwiddie Court House, Dinwiddie County, Va. General Philip Henry Sheridan (q.v.), supported by General Gouverneur Kemble Warren (1830–82), commanded the Union forces in an attack on the entrenched Confederate infantry and cavalry at Five Forks. General Robert Edward Lee (see under LEE) had ordered General George Edward Pickett (q.v.) to hold this position as a defense for the vital South Side Railroad and the White Oak road. Sheridan attacked at 4 P.M. with superior numbers along the 2-mi. front held by Pickett. The Confederates were overwhelmed by the Union charge and fled in retreat, covered by their cavalry. As a result of the battle, the Union forces gained possession of the road and railroad, and shortly thereafter forced Lee to abandon the defense of Richmond and begin his retreat.

FIVE NATIONS, confederation of Indian tribes of Iroquoian stock, consisting of the Mohawk, Onondaga, Cayuga, Oneida, and Seneca. See IROQUOIS.

FIVE-POWER NAVAL TREATY. See WASHINGTON CONFERENCE.

FIVE-YEAR PLAN (Russ. *Piatiletka*), name of each of the series of programs adopted by the government of the Soviet Union for the devel-

FIXTURE

opment of the national economy and cultural life of the country; see UNION OF SOVIET SOCIALIST REPUBLICS. Other nations, including India and China, also use five-year plans.

FIXTURE. See JIGS AND FIXTURES.

FJORD, or **FIORD** (Old Norse *Fjörðr*), inlet of the sea, or a narrow bay, extending far inland between precipitous rock formations, with side arms branching off at many angles. The walls enclosing a fjord continue far below the surface of the water. The greatest depths are always far from the sea; the mouth is usually shallow. Geologists cannot state with certainty how these high-walled sea inlets were formed. The eroding action of rivers over countless centuries, followed over a million years ago by polar glaciers which ripped the coastlines, may have helped give fjords their distinctive characteristics. Later, the sinking of portions of the earth itself, flooding the deep, long valleys near the sea, may have aided in forming the fjords.

The coast of Norway is noted for its many fjords. The Sognefjorden (q.v.), extending inland for 112 mi., attains a depth of 4000 ft. at certain points. The fjords of Oslo, Porsanger, and Trondheim constitute coastal indentations nearly as prominent. Other coastlines on which fjords are found include those of British Columbia, southern Alaska, Iceland, Greenland, Nova Scotia, Maine, lower Argentina, and New Zealand. Similar in various respects to fjords are the sea lochs or firths of the British Isles.

FLACCUS, Quintus Fulvius (fl. 3rd cent. B.C.), Roman statesman and military leader. He was consul in 264 B.C., and again in 237, 224, 212, and 209. Flaccus also held the public offices of censor in 231, pontifex maximus in 216, and praetor urbanus in 215. He distinguished himself in campaigns against the Gauls, Insubrians, and Ligurians, and triumphed over Hanno (q.v.), the Carthaginian general, in 212. The most impressive military operation of his career, however, was the prolonged siege and ultimate capture of Capua (q.v.) in southwestern Italy.

FLACCUS, Quintus Horatius. See HORACE.

FLAG, common name for several monocotyledonous plants having sword-shaped leaves and bearing large asymmetrical flowers. Each flower is dominated by a large petal called a banner. The blue flags of the United States are members of the genus *Iris*. The sweet flag is *Acorus calamus*, and the cattail, or cattail flag, is *Typha latifolia*. See CALAMUS; IRIS.

FLAG, or **BANNER** or **ENSIGN** or **STANDARD**, light piece of cloth, usually rectangular in shape but varying in size, color, and design, and intended for use as an emblem or as a kind of sig-

naling device. A flag is most commonly displayed hanging free from a staff, pole, or rope, to which it is attached along one edge.

The best-known type of flag is that which is used for identification, such as the flag of a country or flags distinguishing governmental subdivisions, officials, agencies, and services; military units; political parties; and various types of organizations and institutions. Some flags convey information, such as those giving notice of an impending storm or a state of quarantine, or as in signaling from one location to another. Flags sometimes also serve as trophies of achievement or victory in athletic contests. A familiar example is a championship pennant, or triangular flag, awarded to the winning teams in the major baseball leagues in the United States.

Flags have been used as symbols of tribal, national, and military identity since ancient times. Carvings, paintings, and writings that have survived from the early Egyptian, Assyrian, Persian, and Hebrew civilizations attest to the use of flags among those peoples. Frequent mention is made of flags in the Bible. Number 2:2 states, "Every man of the children of Israel shall pitch by his own standard, with the ensign of their father's house". Other peoples of antiquity, notably the Greeks, Romans, and Chinese, also used flags. The primitive inhabitants of North and South America used such rudimentary standards as poles fledged with feathers.

Early medieval European flags were largely religious in character. As the nobility developed into a distinct and numerous hereditary class, there came into being a wide variety of standards with heraldic and genealogical insignia. With the formation of national states and the eventual decline of feudalism, national flags became the dominant type of standard.

See FLAG OF THE UNITED STATES; FLAGS, NATIONAL; FLAGS OF THE STATES.

FLAGELLANTS, religious fanatics of 13th-century Europe who proclaimed the imminence of the wrath of God against corruption and, as a religious rite, practiced public, self-inflicted scourgings. The sect arose in Perugia, in central Italy, in 1259-60, and is said to have numbered 10,000. The members would run through the streets of a town lashing themselves about the shoulders and calling upon bystanders to repent and join them in self-castigation. Manfred, King of Naples and Sicily (1232?-66), alarmed at the numbers of the flagellants and the possibility that they might be incited to riot in a country torn by political struggles, attempted to suppress them. The suppression failed to halt the movement, however, for groups of disciples

were already scattered throughout Europe. At first the flagellants were noted for their piety, but as time went by many disreputable people joined the sect. They attacked the Jews in many towns in Germany and the Netherlands, and the church combined with the secular authorities in attempts to prevent their furious outbursts.

The outbreak of the black death (see **PLAGUE**), which raged throughout Europe from 1347 to 1349, encouraged an intensified revival of the movement, the flagellants being convinced that the millennium (q.v.) was at hand. They traveled in organized bands, bound by vows to abstain from all physical pleasures and to endure tortures and whippings for thirty-three days, in memory of the thirty-three years of the life of Christ. In 1349 Pope Clement VI (1291–1352) declared them to be heretical and strove to suppress them. A revival of the movement in several German states early in the 14th century led to persecutions of the flagellants that eventually culminated in the absolute condemnation of the sect by the Council of Constance (1414–18).

In more recent times, too, flagellant sects occasionally have sprung up. A band appeared in Lisbon in 1820; and in Colorado and New Mexico a sect of Christian Indians, the Hermanos Penitentes, continued the practice of scourging until the end of the 19th century.

FLAGELLATES, diverse group of one-celled organisms in the kingdom Protista (q.v.) that have in common whiplike projections called flagella, by which they move about. They may live as single cells, in colonies, or as parasites. Almost any watery niche on earth contains large numbers of flagellates, and they are the primary component of the marine food chain. Because flagellates show a mix of plant, animal, and fungal features, and because as colonies they exhibit coordinated activity, they provide clues to how the multicellular forms of life may have evolved. The dinoflagellates (phylum Pyrrophyta), essentially an algal group, are usually plantlike: they have cell walls, contain chlorophyll, and conduct photosynthesis. But some true dinoflagellates resemble the animallike flagellates (phylum Zoomastigina), which are soft-bodied, colorless, and feed on other organisms. See also **DIATOMS**; **PLANKTON**; **PROTOZOA**.

FLAGEOLET. See **RECORDER**.

FLAGG, James Montgomery (1877–1960), American painter, illustrator, and writer, born in Pelham Manor, N.Y., and educated in art in New York City and Paris. Later he worked with the Bavarian-born painter Sir Hubert von Herkomer (1849–1914) at Herkomer's art school in Bushey, England. Flagg was noted as a magazine illustra-

tor and a portrait painter, and for the facility with which he used the varied media of pen-and-ink, pastel, oil, and watercolor. He began his illustrating career with a drawing for *Saint Nicholas Magazine* at the age of fourteen. Two years later he became a regular illustrator for the humorous periodicals *Judge* and *Life*. Subsequently he made black-and-white illustrations and covers in color for numerous magazines. During World War I he was the official New York State military artist and drew forty-five posters to stimulate public participation in the war effort. In 1941 he made posters to aid the defense program of the United States government preceding its entrance into World War II. That same year he became a staff member of the Associated Press as both artist and writer. He painted the portraits of many celebrities of his time, including the American writer Mark Twain (see **CLEMENS, SAMUEL LANGHORNE**). Among Flagg's writings are *Yankee Girls Abroad* (1900), *If—a Guide to Bad Manners* (1905), *The Adventures of Kitty Cobb* (1912), *Boulevard All the Way—Maybe* (1925), and *Roses and Buckshot* (1946).

FLAG OF THE UNITED STATES, popularly called the American Flag, the official national flag of the United States. It consists of thirteen horizontal stripes, seven red alternating with six white, and, in the upper corner near the staff, a rectangular blue field or canton, containing fifty, five-pointed white stars. The stripes symbolize the thirteen colonies that originally constituted the United States of America. The stars represent the fifty States of the Union. In the language of the Continental Congress (q.v.), which defined the symbolic meanings of the colors red, white, and blue, as used in the flag, "White signifies Purity and Innocence; Red, Hardiness and Valor; and Blue Vigilance, Perseverance and Justice". Because of its stars, stripes, and colors, the American flag is frequently called the Star-Spangled Banner, the Stars and Stripes, and the Red, White, and Blue. Another popular, patriotic designation, Old Glory, is of uncertain origin.

Origins of the American Flag. Early flags designed for use in the American colonies reflected the Old World origin of the colonists. In the British colonies many flags were adaptations of the British Union Jack; see **FLAGS OF THE NATIONS**. The colors red, white, and blue, which symbolized colonial unity, were first used in a flag in New England in 1737. The flag was blue with a white canton quartered (divided into four parts) by a red cross. In one upper quarter of the canton was a globe symbolizing the New World.

FLAG OF THE UNITED STATES

As relations with Great Britain became strained, the colonists designed a large number of flags expressive of their political sentiments and ideals. A favorite emblematic device in the flags of the Southern colonies was a rattlesnake, usually depicted as coiled and ready to strike and having thirteen rattles. In South Carolina it was emblazoned on a yellow flag and was accompanied by the inscription "DONT TREAD ON ME". Another South Carolina colonial flag consisted of thirteen horizontal stripes, seven red alternating with six blue; extending diagonally across the flag toward the upper corner near the staff was a rattlesnake depicted with its forked tongue projecting. A similar Virginia colonial flag differed from the latter South Carolina emblem in two respects: it contained six white instead of six blue stripes, and beneath the serpent was inscribed "DONT TREAD ON ME". Another Virginia flag was white and emblazoned with crossed swords and the motto "LIBERTY OR DEATH".

The idea of liberty appeared on many other flags besides that of Virginia. The word was inscribed on an otherwise plain red flag raised in New York by the Sons of Liberty, a secret patriotic organization, in defiance of a British regulation forbidding the display of any but the British flag. LIBERTY also formed the inscription of a Taunton, Mass., flag consisting of a red field and a blue canton containing the British Union Jack. A favorite device in other colonial flags was the pine tree, called the liberty tree, on a yellow flag borne by the minutemen (q.v.) in 1775. In New England the liberty tree device appeared on a yellow flag bearing the inscriptions "AN APPEAL TO GOD" and "DONT TREAD ON ME". The tree also appeared in the white canton of a red flag that, with other emblems, was borne by the Americans at the Battle of Bunker Hill (see BUNKER HILL, BATTLE OF) on June 17, 1775. The first American colonial flag with stars of which there is a record was that displayed in 1775 by the armed schooner *Lee*. The flag of the *Lee* was white. Near its center was a blue anchor partially enclosed by a scroll, and above the anchor was inscribed the word "HOPE". In the upper corner of the flag was a blue canton containing thirteen five-pointed stars.

To meet the growing need for a flag symbolic of its cause, the Continental Congress appointed a special committee in the latter part of 1775. The committee, which consisted of the diplomat Benjamin Franklin (q.v.) of Pennsylvania, the statesman Benjamin Harrison (q.v.) of Virginia, and the planter Thomas Lynch of South Carolina (1749–79), conferred with the American Revolutionary soldier George Washington

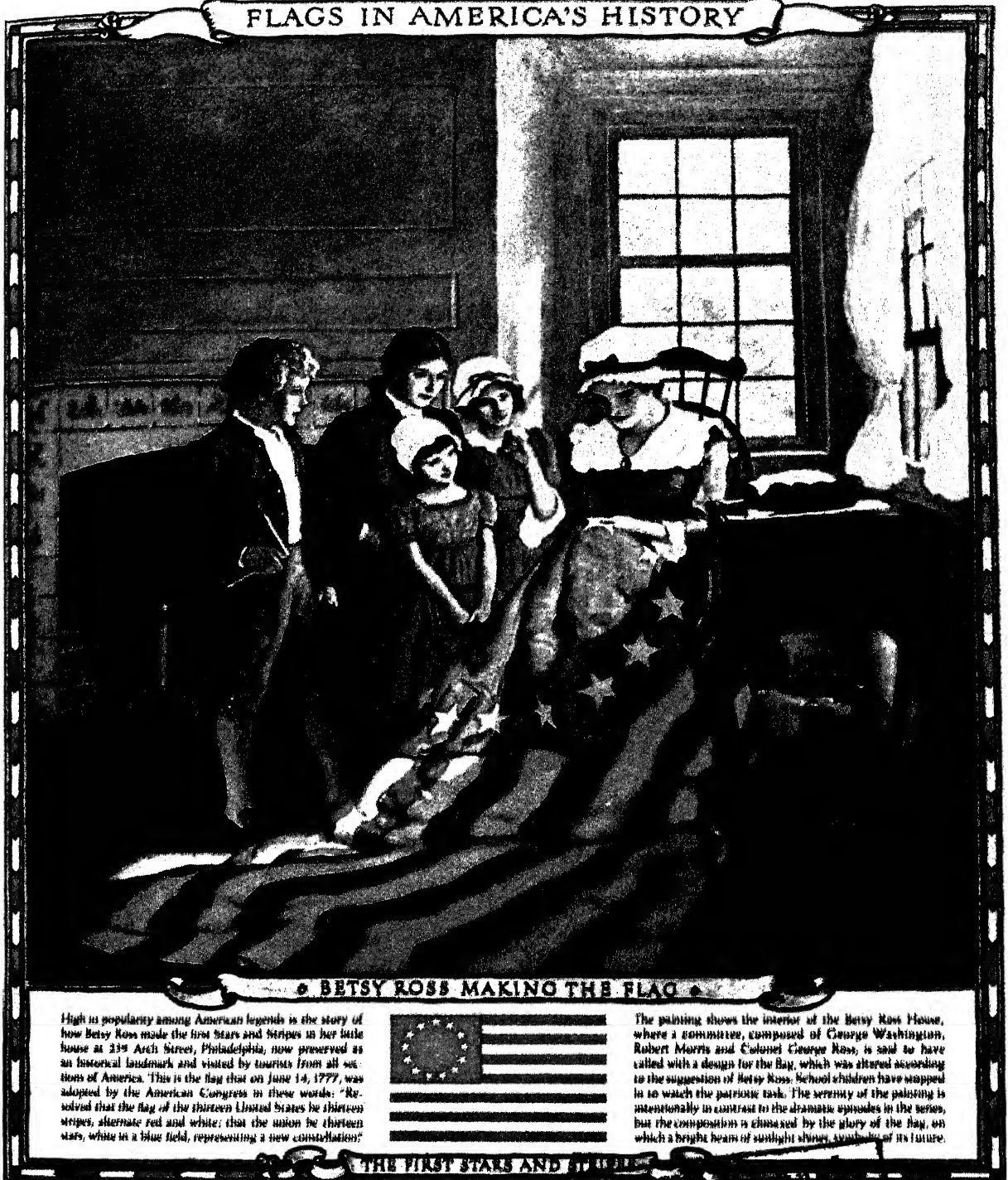
(q.v.) and other Revolutionary leaders; see AMERICAN REVOLUTION. Because the political sentiment prevailing at that time among these leaders was opposed to separation from Great Britain and envisaged eventual reconciliation with the mother country, the flag finally adopted signified the two dominant contemporary political ideas: colonial unity against oppression and continued union with Great Britain. The first idea was represented in the flag by thirteen horizontal stripes, seven red alternating with six white. The second idea was symbolized by including, in a blue canton at the top of the flag near the staff, the crosses of the British Union Jack—the cross of Saint George and the cross of Saint Andrew. This flag, which may have been designed in detail by Francis Hopkinson (q.v.), a signer of the Declaration of Independence, was raised for the first time at Charlestown, Mass., on Jan. 1, 1776. It was known as the Continental flag or the Congress colors. In later times it came to be called the Grand Union, or Cambridge, flag.

Development of the American Flag. On June 14, 1777, Congress made the following resolution: "The flag of the United States shall be thirteen stripes, alternate red and white, with a union of thirteen stars of white on a blue field . . .". Official announcement of the new flag was not made until Sept. 3, 1777. When it was first flown has not been determined. Historical research has failed to establish a factual foundation for the traditional story that the flag-maker Betsy Ross (q.v.) made the first American flag.

Because Congress had made no rule for the arrangement of the stars, they were displayed in different ways. The most usual arrangement was a circle. Occasionally the circle was made to consist of twelve stars with the thirteenth star forming the center of the circle. As new States joined the Union, they demanded representation in the stars and stripes of the flag. In 1795 Congress voted to increase to fifteen the number of stars and stripes. Legislation enacted in 1818 reestablished the number of stripes at thirteen and instituted the policy, "That on the admission of every new State into the Union, one star be added to the union of the flag . . .".

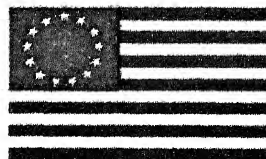
At the time of the Mexican War (q.v.) in 1846 the American flag contained twenty-nine stars. At the start of the Civil War (see CIVIL WAR, THE AMERICAN) in 1861 the flag contained thirty-four stars, including those of the seceding States. By the time of the Spanish-American War (q.v.) in 1898 the flag contained forty-five stars. The forty-ninth and fiftieth stars were added in 1959

FLAGS IN AMERICA'S HISTORY



• BETSY ROSS MAKING THE FLAG •

High in popularity among American legends is the story of how Betsy Ross made the first stars and stripes in her tale house at 239 Arch Street, Philadelphia, now preserved as an historical landmark and visited by tourists from all sections of America. This is the flag that on June 14, 1777, was adopted by the American Congress in these words: "Resolved that the flag of the thirteen United States be thirteen stripes, alternate red and white; that the union be thirteen stars, white in a blue field, representing a new constellation."



The painting shows the interior of the Betsy Ross House, where a committee, composed of George Washington, Robert Morris and Colonel George Ross, is said to have called with a design for the flag, which was altered according to the suggestion of Betsy Ross. School children have dropped in to watch the patriotic task. The serenity of the painting is intentionally in contrast to the dramatic episodes in the series, but the composition is ennobled by the glory of the flag, on which a bright beam of sunlight shines, symbolizing its future.

THE FIRST STARS AND STRIPES

and 1960, respectively, after Alaska and Hawaii were admitted to the Union.

An executive order issued by President William Howard Taft (q.v.) on Oct. 29, 1912, fixed the overall width and length of the U.S. flag, known technically as the hoist and fly respectively, in the ratio of 1:1.9. The thirteen stripes

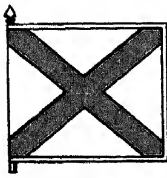
According to legend, the American flag that became the nation's emblem was designed and made by Betsy Ross in 1776.

Bettmann Archive

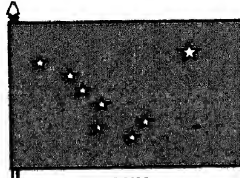
were fixed at equal width. The hoist of the blue field containing the stars was fixed at seven thirteenths of the overall hoist, that is, as extending from the top of the flag to the addition of the

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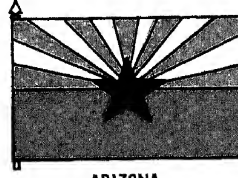
FLAGS OF THE STATES AND TERRITORIES OF THE UNITED STATES



ALABAMA



ALASKA



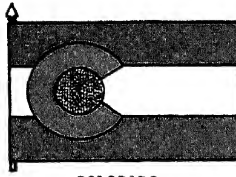
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ARKANSAS



CALIFORNIA



COLORADO



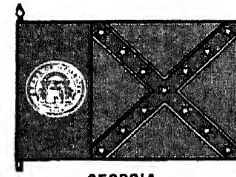
CONNECTICUT



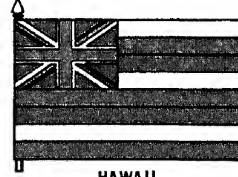
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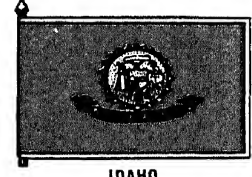
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GEORGIA



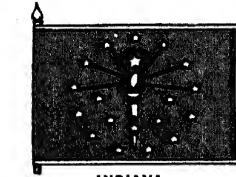
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IDAHO



ILLINOIS



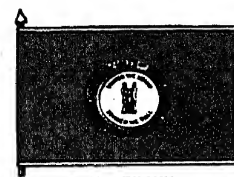
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IOWA



KANSAS



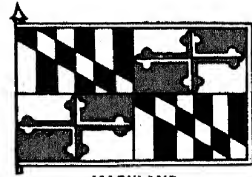
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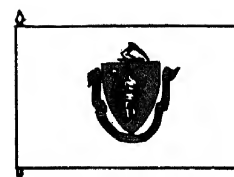
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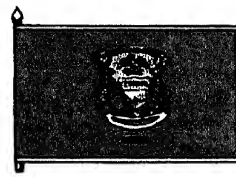
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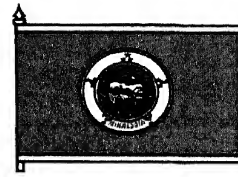
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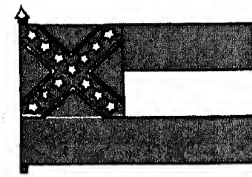
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MICHIGAN



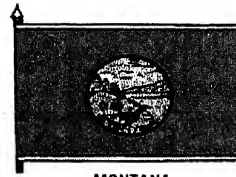
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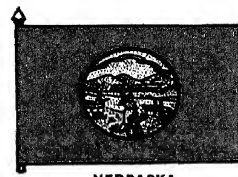
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MISSOURI



MONTANA



NEBRASKA



NEVADA

FLAGS OF THE STATES AND TERRITORIES OF THE UNITED STATES

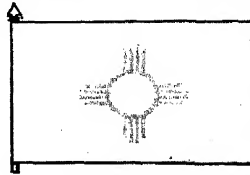
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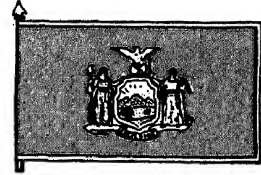
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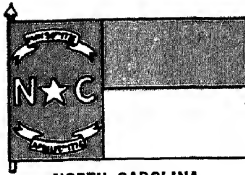
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NEW MEXICO



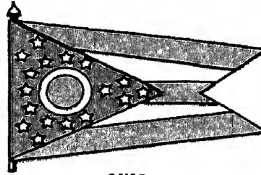
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NORTH CAROLINA



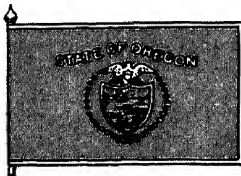
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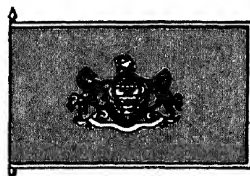
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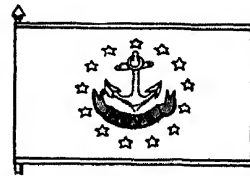
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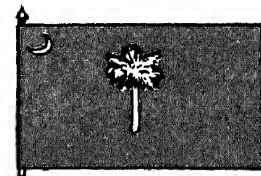
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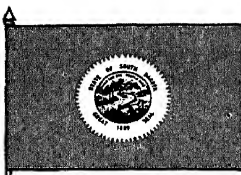
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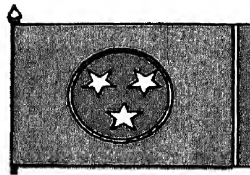
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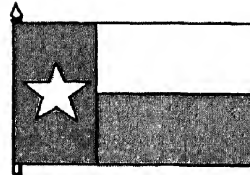
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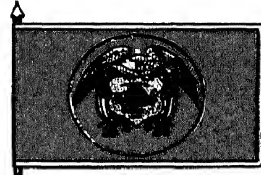
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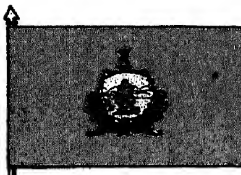
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TEXAS



UTAH



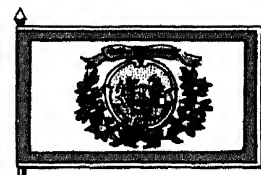
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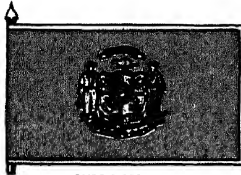
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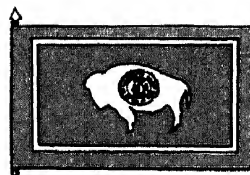
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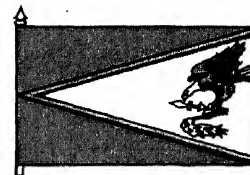
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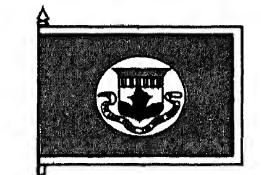
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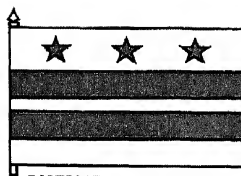
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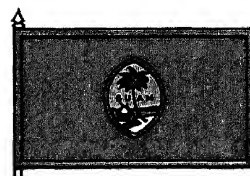
AMERICAN SAMOA



CANAL ZONE



DISTRICT OF COLUMBIA



GUAM



PUERTO RICO



VIRGIN ISLANDS

FLAGS OF THE NATIONS



AFGHANISTAN



ALBANIA



ALGERIA



ANDORRA



ARGENTINA



AUSTRALIA



AUSTRIA



BAHAMAS



BAHRAIN



BANGLADESH



BARBADOS



BELGIUM



BR. HONDURAS (BELIZE)



BHUTAN



BOLIVIA



BOTSWANA



BRAZIL



BULGARIA



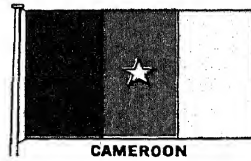
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BURUNDI



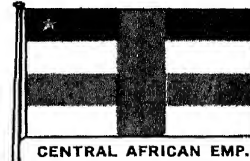
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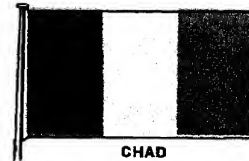
CAMEROON



CANADA



CENTRAL AFRICAN EMP.



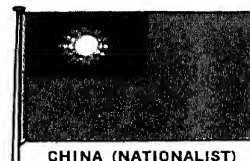
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CHILE



CHINA (P. REP.)



CHINA (NATIONALIST)



COLOMBIA



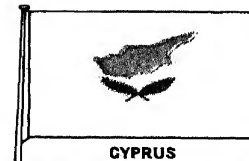
CONGO (REP. OF)



COSTA RICA



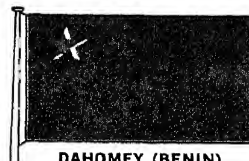
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CYPRUS



CZECHOSLOVAKIA



DAHOMY (BENIN)



DENMARK



DOMINICAN REP.



ECUADOR



EGYPT, ARAB REP. OF

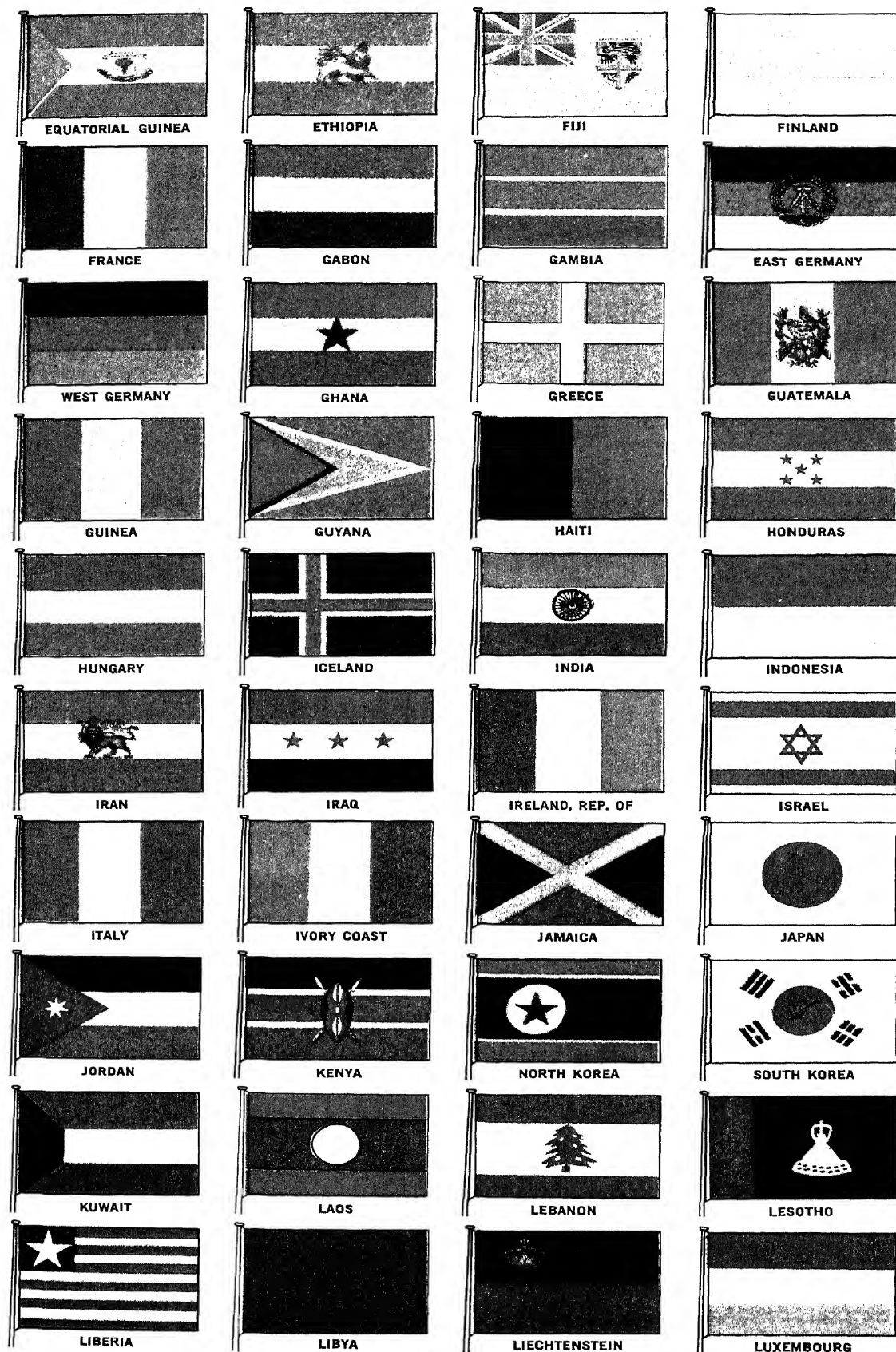


EL SALVADOR

For flag of CEYLON see SRI LANKA

FLAGS OF THE NATIONS

II



For flag of GREAT BRITAIN see UNITED KINGDOM

III

FLAGS OF THE NATIONS



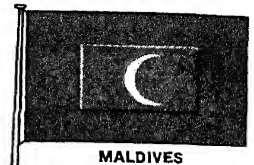
MALAGASY REP.



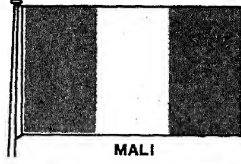
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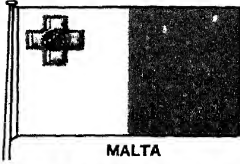
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MALDIVES



MALI



MALTA



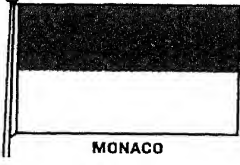
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MAURITIUS



MEXICO



MONACO



MONGOLIA



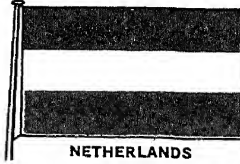
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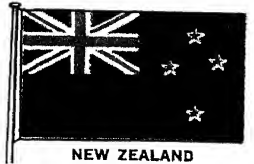
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NEPAL



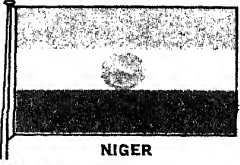
NETHERLANDS



NEW ZEALAND



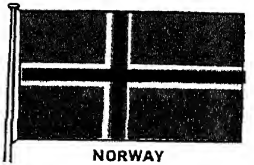
NICARAGUA



NIGER



NIGERIA



NORWAY



OMAN



PAKISTAN



PANAMA



PARAGUAY



PERU



PHILIPPINES



POLAND



PORTUGAL



QATAR



RHODESIA



RUMANIA



RWANDA



SAN MARINO



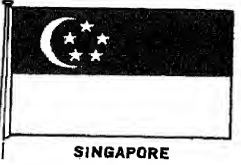
SAUDI ARABIA



SENEGAL



SIERRA LEONE



SINGAPORE



SOMALIA



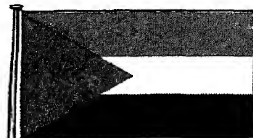
SOUTH AFRICA, REP. OF



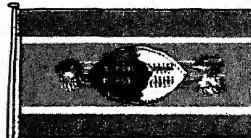
SPAIN



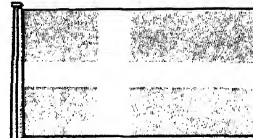
SRI LANKA (CEYLON)



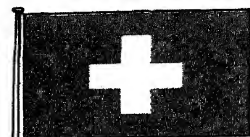
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SWAZILAND



SWEDEN



SWITZERLAND



SYRIA



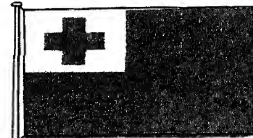
TANZANIA



THAILAND



TOGO



TONGA



TRINIDAD & TOBAGO



TUNISIA



TURKEY



UGANDA



U.S.S.R.



UNITED ARAB EMIRATES



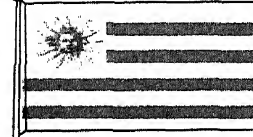
U.K. (GREAT BRITAIN)



UNITED STATES



UPPER VOLTA



URUGUAY



VATICAN CITY



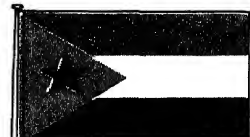
VENEZUELA



VIETNAM



WESTERN SAMOA



YEMEN (P.D.R.)



YEMEN ARAB REP.



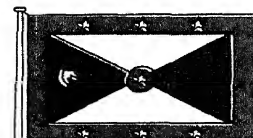
YUGOSLAVIA



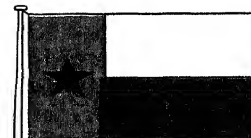
ZAIRE



ZAMBIA



* GRENADA (1974)



* GUINEA-BISSAU (1974)



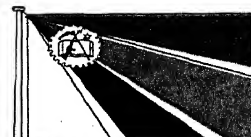
* ANGOLA (1975)



* CAPE VERDE (1975)



* COMORO ISLANDS (1975)



* MOZAMBIQUE (1975)



* PAPUA NEW GUINEA (1975)



* SÃO TOMÉ AND PRÍNCIPE (1975)



* SURINAM (1975)

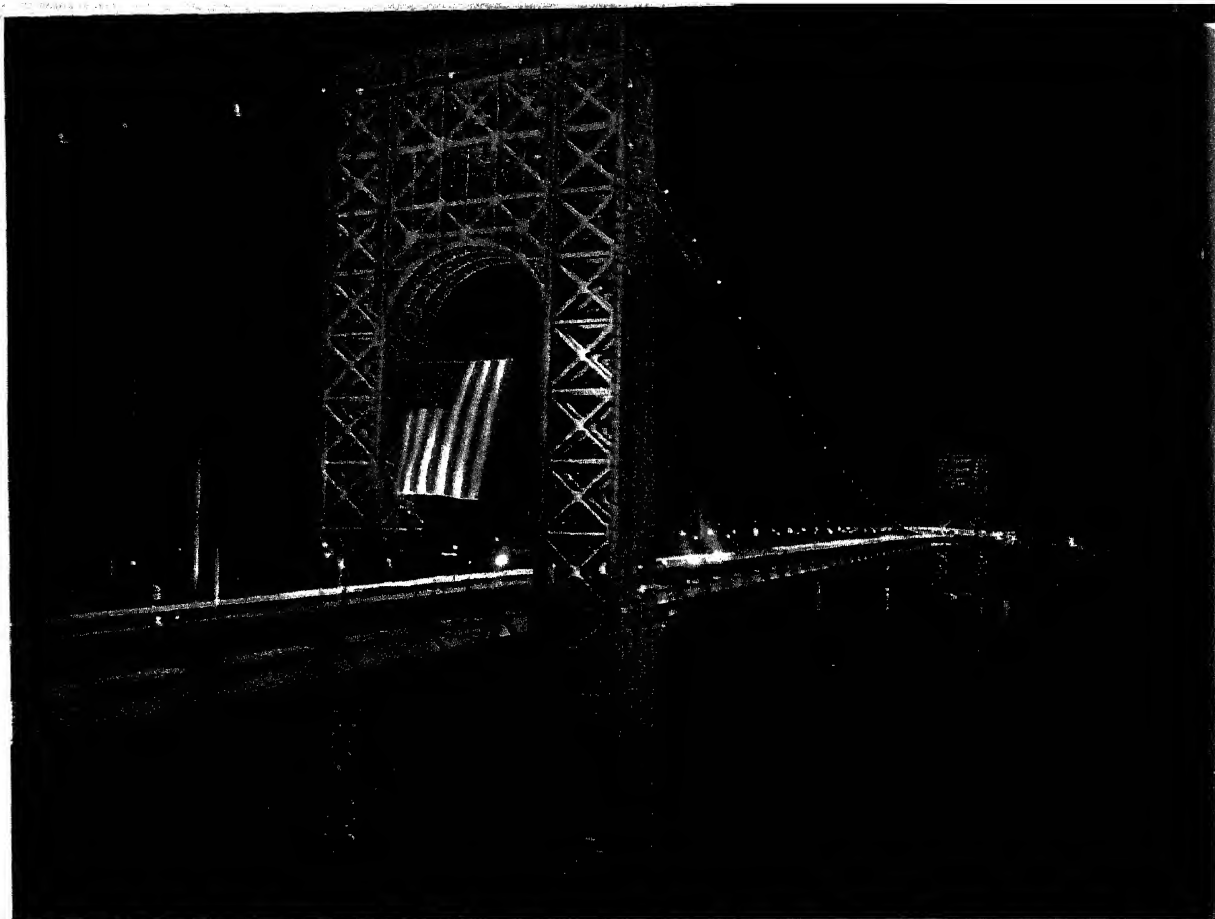


* SEYCHELLES (1976)



* DJIBOUTI (1977)

* Nations independent since 1974



The latest American flag, with fifty stars for the fifty States, on the George Washington Bridge over the Hudson River.
Port Authority of New York and New Jersey.

seventh stripe. The fly of the blue field was fixed at a tiny fraction over three fourths of the overall hoist. The diameter of each star was established as a minute fraction under one sixteenth of the overall hoist.

Display of the American Flag. A joint resolution adopted by Congress in 1942 established a uniform code for display of the national flag. Included are the following rules.

The flag is usually displayed from sunrise to sunset in the open. It should be raised briskly and lowered ceremoniously. It is displayed daily, weather permitting, and especially on certain enumerated holidays, on or near the main administration buildings of all public institutions. It is also displayed in or near every polling place on election days and in or near every schoolhouse during school days.

When carried in processions with another flag, the U.S. flag is borne to the right of the other emblems carried by the marchers. When carried with several other flags, it may be borne in front of the center of the line formed by the other standards. No other flag or pennant should be placed above the U.S. flag. When dis-

played against a wall or in a window, the blue field should be uppermost and to the left of the observer. When displayed flat on a speaker's platform, the flag should be behind and above the head of the speaker.

A number of rules regulate the display of the flag at various public ceremonies and its display in connection with State and city flags and in churches. Other rules deal with the observance of proper respect for the American flag. The latter are supplemented in most of the States by laws prohibiting the use of the U.S. flag for advertising purposes. The armed services have detailed regulations for military and naval uses of the flag.

Other Official United States Flags. The official flag of the President is a blue or azure emblem containing a white star in each corner and, in the center, a representation of the official Presidential seal. Each of the heads of the executive departments has an official flag, as do many of the agencies of these departments and the independent Federal agencies. The branches of the armed forces also have official flags.

FLAGS, NATIONAL, flags distinctively designed to serve as the emblem of a particular nation. Many countries have both an official flag,

which is the symbol of the nation, and a government flag, usually the official national flag with a superimposed identifying emblem, which is flown above government properties. The preceding color charts show the national flag of individual countries.

FLAGS OF THE STATES, official flags of the States of the United States. The accompanying color chart shows the flag of each State and U.S. territory.

The years of the adoption of the flag by States are: Alabama, 1895; Alaska, 1927; Arizona, 1917; Arkansas, 1913; California, 1911; Colorado, 1929; Connecticut, 1897; Delaware, 1912; Florida, 1899; Georgia, 1956; Hawaii, 1925; Idaho, 1907; Illinois, 1915; Indiana, 1917; Iowa, 1921; Kansas, 1927; Kentucky, 1918; Louisiana, 1912; Maine, 1909; Maryland, 1904; Massachusetts, 1908; Michigan, 1911; Minnesota, 1893; Mississippi, 1894; Missouri, 1913; Montana, 1905; Nebraska, 1925; Nevada, 1929; New Hampshire, 1909; New Jersey, 1896; New Mexico, 1925; New York, 1901; North Carolina, 1885; North Dakota, 1911; Ohio, 1902; Oklahoma, 1925; Oregon, 1925; Pennsylvania, 1907; Rhode Island, 1897; South Carolina, 1861; South Dakota, 1909; Tennessee, 1905; Texas, 1876; Utah, 1913; Vermont, 1923; Virginia, 1861; Washington, 1923; West Virginia, 1929; Wisconsin, 1913; Wyoming, 1917. The District of Columbia adopted its flag in 1938.

The years of the adoption of the flag by territories are: American Samoa, 1960; Guam, 1948; Puerto Rico, 1952; Virgin Islands, 1921. The territory of the Canal Zone has no official flag.

FLAGSTAD, Kirsten (1895–1962), Norwegian operatic soprano, born in Hamar, near Oslo. She studied music with her mother and later in Oslo. After making her operatic debut in 1913 at the National Theater, Oslo, in *Tiefland* by the Scottish-born composer Eugen d'Albert (1864–1932), she studied further in Stockholm. Until 1933 she sang only in the Scandinavian countries, and her repertory included many roles in both light and grand opera. She sang a number of minor roles in operas by the German composer Richard Wagner (q.v.), as well as the part of Sieglinde in Wagner's *Die Walküre* at the famous festival in Bayreuth (q.v.) in 1933 and 1934.

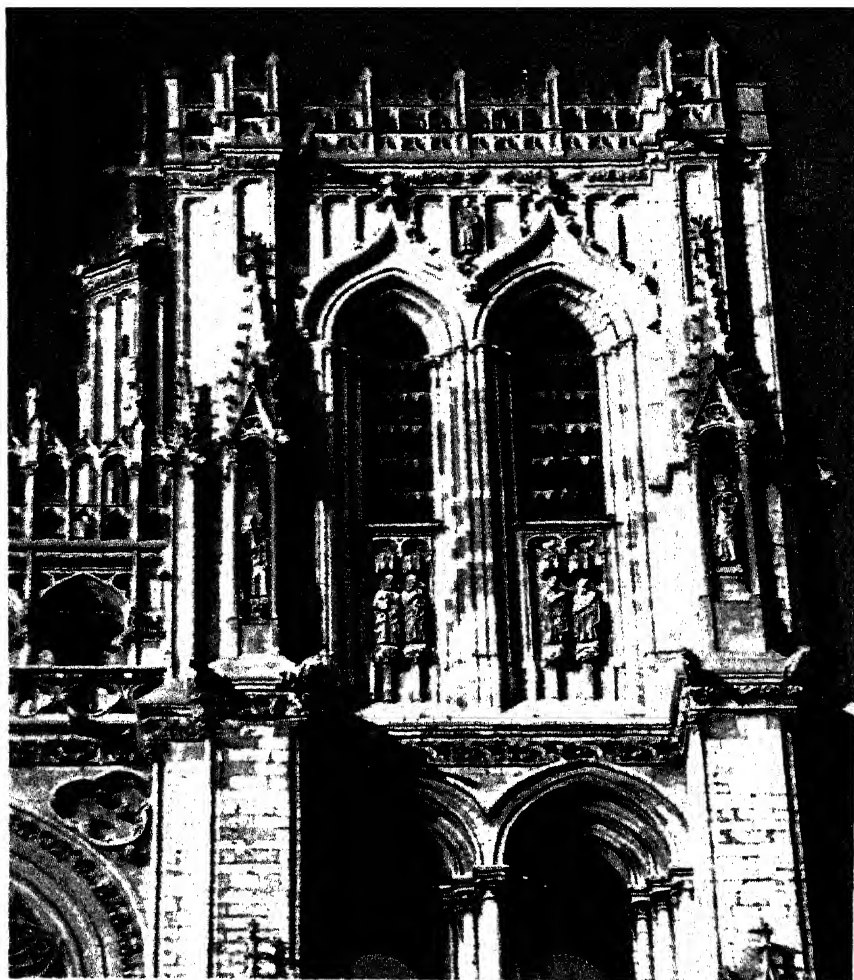
In 1935 she made her first appearance at the Metropolitan Opera House in New York City, in the role of Sieglinde. At the Metropolitan she established herself as one of the foremost Wagnerian sopranos of the day, particularly in the role of Isolde in *Tristan und Isolde*. She remained with the Metropolitan until 1941 when she returned to Europe. In 1947–48 she toured

the United States in recital, and made her final appearance with the Metropolitan during the 1951–52 season. Her repertory included not only the leading feminine roles in Wagner's *Ring of the Nibelungen*, *Tannhäuser*, *Lohengrin*, and *Parsifal*, but also in such roles as Leonore in *Fidelio* by the German composer Ludwig van Beethoven, Marguerite in *Faust* by the French composer Charles François Gounod, and the title role of *Aïda* by the Italian composer Giuseppe Verdi (qq.v.). In 1958–59 she directed the Norwegian State Opera.

FLAGSTAFF, city in Arizona, and county seat of Coconino Co., 6907 ft. above sea level, about 100 miles N.E. of Prescott. The city lies at the foot of the San Francisco Peaks. The highest of the peaks is Humphreys Peak (12,633 ft. above sea level), which is also the highest point in the State. Coconino County is the second-largest county in the United States, greater in size than Vermont, Massachusetts, and Rhode Island combined. The leading industries in the city and the surrounding area are lumbering and the raising of cattle and sheep.

Flagstaff is the headquarters for the Coconino National Forest and the site of Northern Arizona University (founded 1899). The Museum of Northern Arizona, containing exhibits on the arts and industries of the Hopi and Navajo Indians, is located in Flagstaff. The city is also the site of the Lowell Observatory, founded in 1894 by the American astronomer Percival Lowell (see under LOWELL). The city is popular as a vacation resort, with facilities for hunting, fishing, and winter sports. The Arizona Snow Bowl, N.W. of Flagstaff, is one of the most-favored winter-sports areas in the Southwest. A winter-sports carnival and the All-Indian Pow-Wow, an event that features three days of rodeos, parades, and tribal ceremonies, are held annually in Flagstaff. Nearby are Montezuma Castle National Monument, Grand Canyon and Petrified Forest national parks, and the Painted Desert (qq.v.). Pop. (1960) 18,214; (1970) 26,117.

FLAHERTY, Robert Joseph (1884–1951), American explorer and motion-picture director, born in Iron Mountain, Mich., and educated at the Michigan College of Mines (now Michigan College of Mining and Technology) and the Upper Canada College, Toronto. Between 1910 and 1916 he led a number of exploratory expeditions into the subarctic regions of Canada. He returned to those regions in 1920, and spent more than a year making a film record of the daily life of an Eskimo family. The result, *Nanook of the North*, was released in 1922. This early specimen of the documentary film is generally recognized



The north tower of the Cathedral of Notre Dame at Amiens provides an interesting example of a Flamboyant exterior. Although the cathedral itself, the largest and one of the most beautiful in France, was completed in the 13th century, the two towers that flank the facade were added in the 14th and 15th centuries. The Flamboyant style, the last phase of French Gothic architecture, is characterized by lofty proportions, intricate carvings and tracery, and numerous niches and pinnacles.

Scala

as a classic, by virtue of its honest simplicity and its revolutionary techniques. In 1923 Flaherty began a sojourn of one year in Samoa, where he compiled a similar account, dealing with the people of that island. The film, *Moana*, was released in 1925. Other films which he produced are *Man of Aran* (1932–34), *Elephant Boy* (1935), *The Land* (for the United States Department of Agriculture, 1942), *The Louisiana Story* (1948), and *The Titan* (1950). His autobiography, *A Film-Maker's Odyssey*, was published in 1939.

FLAMBOYANT, in architecture, term used to describe the late Gothic style in France; see **GOthic ARCHITECTURE**. Its currency extends through the 15th and early 16th centuries, corresponding with the Perpendicular (q.v.) style in England. The name means "flamelike" in French and derives from the convoluted forms of the tracery, which replaced the geometric forms of earlier work. The style appears not only in windows but also on wall surfaces, buttresses, choir screens, and woodwork. In the Flamboyant style carved ornamentation is characterized by its intricacy and minuteness of detail, and the great number and variety of subordinate decorative buttresses and pinnacles. Other features are the

use of flattened elliptical arches, the ogee curves of the moldings over all the arches, the tall, slender bases, and the multitude of minute canopies and pinnacles.

Remarkable among the buildings in the style are Saint Maclou, the west front of the cathedral, and the Palais de Justice all in Rouen, Saint Jacques in Dieppe, Saint Vulfran in Abbeville, and the cathedrals of Tours and Troyes. The northern spire of the Cathedral of Notre Dame in Chartres is considered one of the most beautiful examples of Flamboyant style in France.

FLAME, glowing body of mixed gases undergoing the process of combustion (q.v.). Flames generally consist of a mixture of oxygen (or air) and another gas (q.v.), usually consisting of such combustible substances as hydrogen, carbon monoxide, and hydrocarbon gases. See separate articles on most of the gases mentioned in this article.

A typical flame is that of a burning candle. When the candle is lit, the heat of the match melts the wax, which is carried up the wick and then vaporized by the heat. The vaporized wax is then broken down by the heat and, finally, combines with the oxygen of the surrounding

air, producing a flame and generating heat and light (q.v.). The candle flame consists of three zones that are easily distinguished. The innermost zone, a nonluminous cone, is composed of a gas-air mixture at a comparatively low temperature. In the second, or luminous cone, hydrogen and carbon monoxide are produced by decomposition and begin to react with oxygen to form water and carbon dioxide respectively. In this cone the temperature of the flame—about 590° to 680° C. (1090°–1250° F.)—is great enough to dissociate the gases in the flame and produce free particles of carbon, which are heated to incandescence and then consumed. The incandescent carbon produces the characteristic yellow light of this portion of the flame. Outside the luminous cone is a third, invisible cone in which the remaining carbon monoxide and hydrogen are finally consumed.

If a cold object is introduced into the outer portions of a flame, the temperature of that part of the flame will be lowered below the point of combustion, and unburned carbon and carbon monoxide will be given off. Thus if a porcelain dish is passed through a candle flame, it will receive a deposit of carbon in the form of soot. Operation of any kind of flame-producing stove in an unventilated room is dangerous because of the possibility of the production of poisonous carbon monoxide gas.

All combustible substances require a definite proportion of oxygen for complete burning. In the burning of a candle, or of solids such as wood or coal, this oxygen is supplied by the surrounding atmosphere. In blowpipes and various types of gas burners, air or pure oxygen is mixed with the gas at the base of the burner so that the carbon is consumed almost instantaneously at the mouth of the burner. For this reason such flames are nonluminous. They also occupy a smaller volume and are proportionately hotter than a simple candle flame. The hottest portion of the flame of a Bunsen-burner, so-called after the German chemist Robert Wilhelm Bunsen (q.v.), has a temperature of about 1600° C. (2910° F.). The hottest portion of the oxygen-acetylene flames used for welding metals reaches a temperature of 3500° C. (6330° F.); see WELDING. Such flames have a bluish-green cone in place of the luminous cone; if the oxygen supply is reduced, such flames have four cones; nonluminous, bluish-green, luminous, and invisible.

The blue-green cone of any flame is often called the reducing cone, because it is insufficiently supplied with oxygen and will take up oxygen from substances placed within it. Simi-

larly the outermost cone, which has an excess of oxygen, is called the oxidizing cone.

The hottest man-made flame is the atomic hydrogen flame (q.v.).

FLAMENCO. See DANCE: *Ethnic Dance: Spain*; FOLK MUSIC: *National and Group Types: Spain*.

FLAME TEST. See SPECTRUM: *Applications*.

FLAME THROWER, military weapon used to project flame at the enemy. A flame thrower consists of a fuel container filled with oil, a cylinder containing a gas propellant (usually carbon dioxide) under high pressure, and a discharge tube with an adjustable nozzle and an ignition device. During World War I two styles of flame throwers were used: a heavy one mounted on a tank, and a light, portable one which was carried by infantrymen.

The flame thrower had great psychological impact on World War I because it succeeded in frightening the enemy. As a weapon, however, it was limited by short range, uncertain aim, and almost 90 percent of the fuel being consumed before the flame reached its target.

By World War II the nozzle design had been improved, allowing for greater range, and, because a thickened fuel was used, almost 90 percent of the fuel reached the target. The standard United States Army portable flame thrower was able to project a 60-ft. flame for about 9 sec. Pack flame throwers were most often used in combat, and were important in the Pacific theaters of war. Flame throwers were indispensable because they effectively drove Japanese troops from caves and pillboxes.

The thickened gasoline, napalm, was developed during World War II as an improved fuel for flame throwers and other incendiaries.

FLAMINGO, large gregarious water bird comprising the family Phoenicopteridae, and closely related to the ducks and geese. The bird measures about 5 ft. from the tip of the bill to the feet. The legs and neck of the flamingo are extremely long, accounting for much of its height. Its feet are webbed. The plumage varies in color from pink to red, except for the large wing feathers which are black, or edged in black. The wings are long and pointed, and the tail is short. The bill is red with a black tip and curves abruptly downward.

Flamingos feed principally on *Cerithium*, a genus of small mollusks. While feeding, they stand in shallow water, dip the head and part of the long neck under water, and scoop backward with the head upside down. When the bill is closed, the sand that is taken in with food strains out through the fluted sides of the bill. When flamingos prepare for flight they first



Flamingos, with their long necks and legs and their webbed feet, are remarkably well adapted for their lives as water birds.

M. Phillip Kahl, Jr.—Photo Researchers

begin running forward, waving their wings and increasing their speed until they are virtually skimming the surface of the water and their wings are able to lift their weight. This process is reversed when they alight. Their call is a deep honk, which resembles the call of certain geese. They are found chiefly on deserted sections of islands in the West Indies, living and breeding in colonies. Flamingos are so specifically adapted to a secluded existence that the constant encroachment of civilization threatens them with extinction.

Flamingos breed in swamps, shallow ponds, and lagoons in May and June. Their nests consist of conical mounds of mud built in shallow water, and measure about 1½ ft. in diameter at the base and 1 ft. high. The top of the mound is hollowed out with the bill and one or two white eggs are laid in the depression. The male and female alternate in sitting on the nest. Many eggs are broken when the flamingos leave their nests suddenly, as they do when they are alarmed; vultures, lizards, and poachers account for a yearly loss of many more eggs. The young hatch after 28 days and, because of their helplessness, must be fed for several months on regurgitated food.

FLAMINIAN WAY. See FLAMINIUS, GAIUS.

FLAMININUS, name of a patrician family of ancient Rome, the most famous members of which were the following.

Titus Quinctius Flamininus (230?–174 B.C.), general and statesman. He was quaestor in 199 and consul in 198 B.C. In 198 B.C. he was ordered to conduct a campaign in Macedonia against Philip V (q.v.), King of Macedonia, and set sail for Greece with a small army. Using Epirus as his base he entered Macedonia and attacked Philip's army, killing 2000 men and driving the rest toward Thessaly.

Meanwhile, his brother Lucius Quinctius Flamininus (see below), who was in command of the fleet, induced the Achaean League (q.v.) to take sides with the Romans. Titus was thus enabled to demand, as a price for a truce, that the Macedonian garrisons be withdrawn from Greece. When Philip was unwilling to yield, envoys from Philip and from Titus were sent to Rome. There the Senate gave the Roman general full authority to prosecute the war to the end. The opposing armies met in 197 B.C. at Cynoscephalae, where the Roman legions clashed with the Macedonian army in a decisive battle. Titus, as victor, deprived Philip of all of his possessions in Greece and Asia, but left Macedonia intact. In 196 B.C., at Corinth, Titus declared the independence of all Greek states previously under Macedonian rule.

Titus became ambassador to Prusias II, King

of Bithynia (r. 192–148 B.C.), in 183 B.C., when the aged Carthaginian general Hannibal (q.v.) was driven to commit suicide from fear of being delivered to the Romans. The Greek biographer Plutarch (q.v.) wrote a biography of Titus.

Lucius Quinctius Flaminius (d. 170 B.C.), admiral, brother of Titus Quinctius. He was curule edile in 200 and praetor in 199 B.C. In the war against Philip V, King of Macedonia, in 198, Lucius commanded the Roman fleet, and besieged the city of Eretria (now Néa Psará) in Euboea, which was defended by a Macedonian garrison. He soon gained possession of all Euboea and then returned to the west coast of Greece and laid siege to Cenchreae (now Kekhriaís), the harbor of Corinth.

In 192 B.C. he was consul. The following year he became proconsul in Gaul (q.v.), where his rule made him unpopular. In 184 B.C. he was arraigned before the Senate and expelled from that body.

FLAMINIUS, Gaius (d. 217 B.C.), Roman statesman and general, of plebeian family (see **PLEBS**). He was tribune in 232 B.C., when, in opposition to conservative members of the Senate, he succeeded in having a law enacted for the distribution among the plebeians of a tract of land south of Ariminum (now Rimini) newly conquered from the Gauls (see **GAUL**). During his term as censor in 220 he extended to Ariminum the military road, known as the Flaminian Way, which extended from Rome to Spoletium (now Spoleto). He also built the Circus Flaminius and in all probability inaugurated the plebeian games. In 218 he further incurred the enmity of the conservatives by supporting a measure barring senators and their sons from owning seagoing vessels except to transport the produce of their own estates. Elected consul once more in 217, he assumed command of the army to oppose the advance of the Carthaginian general Hannibal (q.v.). Flaminius led his troops from Ariminum to Arretium (now Arezzo), but was surprised on the shores of Lake Trasimenus (see **TRASIMENO, LAKE**), and was slain in a violent battle in which half of his army of 30,000 perished.

FLAMSTEED, John (1646–1719), English astronomer, born in Denby, and educated at the free school of Derby. In 1675 he was appointed the first astronomer royal of England. In the following year after the observatory at Greenwich had been built for his use, he began a series of observations which, by exposing and correcting the large number of errors in contemporary astronomical tables, helped to mark the beginning of modern practical astronomy. He formed a catalog of the fixed stars, and from his lunar ob-

servations furnished the data which his contemporary the English astronomer and physicist Sir Isaac Newton (q.v.) used for the verification of his theory of gravity.

FLANAGAN, Edward Joseph (1886–1948), American Roman Catholic clergyman, born in Roscommon, Ireland, and educated at Mount Saint Mary's College and Gregorian University, Rome. He came to the United States in 1904, and was ordained a priest after completing his studies at the Jesuit University, Innsbruck, Austria, in 1912. In 1914, while serving as assistant pastor at Saint Patrick's Church, Omaha, Nebr., he established the Workingmen's Hotel as a place of refuge for destitute men. Three years later he turned to the work of youth rehabilitation, setting up the Home for Homeless Boys, at Omaha, initially with a group of five boys. Operating on the belief, which Father Flanagan often expressed, that "There is no such thing as a bad boy", the home grew rapidly and became nationally famous. It was eventually moved to a site 10 mi. from Omaha. The home was named Boys Town, and was incorporated as a village. It was open to boys of all religions and was governed by a mayor and six commissioners elected by the boys from among themselves. Boys' towns based on Father Flanagan's ideas have also been opened in other countries; see **BOYS TOWN**.

Father Flanagan was created a domestic prelate, with the title Right Reverend Monsignor, in 1937, and in the following year received the humanitarian award of the Variety Clubs of America. A motion picture portraying the ideals and activities of Father Flanagan and his home for boys was released in 1938. In 1947 at the invitation of the United States Army he visited Japan on a tour of inspection of youth facilities there. He died during a similar tour in Germany.

FLANDERS (Fr. *Flandre*; Flemish, *Vaanderen*), name applied originally to the immediate territory surrounding the city of Bruges, and, after the 8th century to the extensive region embracing the present provinces of East and West Flanders in Belgium, the southern portion of Zeeland Province in the Netherlands, and Nord Department in France. Flanders was inhabited by Celts in the 1st century B.C. (see **CELTIC PEOPLES AND LANGUAGES**), and conquered by Germanic tribes in the next several hundred years, finally becoming a part of the empire established by Charlemagne (q.v.), Holy Roman Emperor.

About 862 Baldwin I (d. 879), son-in-law of Charles II (q.v.), Holy Roman Emperor, was created the first count of Flanders. Under Baldwin I and Baldwin II (d. 918) Flanders was made



A picturesque canal in Bruges, capital of West Flanders Province in Belgium. Bruges is sometimes called the "City of Bridges".

Bernard G. Silberstein

secure against the incursions of the Northmen (q.v.). In the early part of the 10th century Baldwin III (d. 962) laid the basis for the industrial and commercial greatness of the region by establishing the woolen and silk industries at Ghent, and instituting annual fairs at Bruges, Ypres (now Ieper), and other towns. In the 11th century Flanders acquired Valenciennes, the burgraviate of Ghent, and the land of Waes and Zeeland from Henry II (q.v.), Holy Roman Emperor. As a result Flanders became a feudatory of the Holy Roman Empire (Imperial Flanders), as well as of the French crown (Crown Flanders). During the rule of Count Baldwin V (d. 1067), the territory between the Scheldt and Dender rivers and the margraviate of Antwerp were added to Flanders. By the middle of the 11th century Flanders had acquired power equivalent to that of a kingdom, and its rulers wielded considerable influence in the political affairs of western Europe. Baldwin V was appointed regent of France following the death of Henry I (q.v.), King of France, in 1060. Matilda (1035–83), Baldwin's eldest daughter, became queen of England as the wife of William the Conqueror (see WILLIAM I). Baldwin of Mons (d.

1070), Baldwin's eldest son, was count of Hainaut, and Robert I, the Frisian (1013?–93), another son, was regent of Holland. When Baldwin V died, Baldwin of Mons, Count of Hainaut, also became Count of Flanders.

Between 1191 and 1280 Flanders and Hainaut were ruled as a united countship. In 1280 following the death of Margaret of Flanders (1200?–80) the union was dissolved. Margaret's son Guy de Dampierre (1225–1305) succeeded to the countship of Flanders, and her grandson John II of Avesnes (d. 1304) became Count of Hainaut. In the early 14th century Flanders was invaded and subjugated by Philip IV (q.v.), King of France. Although the countship was acknowledged nominally, France became the real ruler of Flanders. In 1369 Burgundy acquired Flanders through the marriage of Philip the Bold, Duke of Burgundy (1342–1404), to Margaret of Flanders (1350–1405), daughter of Louis II, Count of Flanders (1330–83). The history of the county as an independent state ceased that year. In 1477, on the death of Charles (q.v.), called Charles the Bold last Duke of Burgundy, Flanders passed to the House of Hapsburg (q.v.), when Charles's daughter, Mary of Burgundy (1457–82), married Maximilian, Archduke of Austria, later Maximilian I (q.v.), Holy Roman Emperor. In 1543 during the reign of Charles V

(q.v.), Holy Roman Emperor, a large part of Flanders was included in the Netherlands. In the last years of the 16th century Flanders was devastated in the course of the uprising of the people of the Netherlands against Spanish rule. In the first half of the 17th century the northwest portion of Flanders, called Dutch Flanders, was ceded to the United Provinces of the Netherlands by Philip IV (q.v.), King of Spain. The partition of the medieval county continued when France acquired the portion known as French Flanders by a succession of treaties, namely, the Pyrenees (1659), Aix-la-Chapelle (1668), Nijmegen (1679), and Utrecht (1713), the last-named ending the War of the Spanish Succession. By the Treaty of Rastadt and Baden in 1714, supplementing the Treaty of Utrecht, what remained of the Spanish Netherlands again passed to the Hapsburgs of Austria. In the Napoleonic period from 1795 to 1814, Flanders was incorporated into the French Empire. In 1815 the Congress of Vienna united Flanders with Belgium and Holland to form the kingdom of the Netherlands. Between 1830 and 1832 Belgium regained its independence, and retained the portions of Flanders now comprising the provinces of East and West Flanders. See BELGIUM; FLEMISH ART AND ARCHITECTURE; FLEMISH LANGUAGE AND LITERATURE; NETHERLANDS, THE.

FLATFISH, certain important food fishes belonging to the order Pleuronectiformes, which in the adult form have flat bodies and both eyes on one side of the head. The body is elliptical and flattened from right to left, so that the dorso-ventral distance is increased. Most species are marine, and they are found in all parts of the world. Flatfish are able to swim on their sides, but habitually lie on the bottom, partially covered, and feed upon small marine animals. In one flatfish family, the Pleuronectidae, the lower jaw is equipped with strong teeth for the purpose of crushing the shells of its prey. The larvae are bilaterally symmetrical and swim in the characteristic position of most other fish. As development progresses, one eye, usually the left, migrates over the top of the head, or, in some species, directly through the skull, and becomes situated over the other eye. A bony ridge extending from the tail to the snout develops to support the dorsal fin. In species having a long larval life this bony ridge may develop before the eye migrates. The ventral and anal fins are confluent, and outline the ventral side of the animal. The skull becomes greatly compressed and the face is permanently distorted to face upward. The eyes are able to move independently, so that the fish can see in all directions as

it lies on the bottom. Flatfish exhibit a remarkable degree of protective coloration. Those living on sandy bottoms have light brown upper sides, and those living on pebbled bottoms have speckled upper sides. The hidden side is usually light in color, but changes to resemble the upper side when exposed to light.

The oldest fossil flatfish belong to the Upper Eocene; see EOCENE EPOCH. Most ichthyologists believe that flatfish are related to the perch group, but the stages in the course of their evolutionary history leading to their highly specialized development are obscure.

The order Pleuronectiformes is composed of four families of flatfish: the Pleuronectidae (which include right-eyed flounders, Pacific halibut, Atlantic halibut, and curlfin turbot); the Soleidae (soles), in which the pelvic fins are rudimentary, the teeth absent, and the eyes reduced in size and situated close together on the right side of the head; the Bothidae (left-eyed flounders, California halibut, and others); and the Cynoglossidae (tongue soles). They average a length of 12 in. Many species of flatfish are eaten as a major source of food.

FLATFOOT. See FOOT.

FLATHEAD INDIANS or **SALISH INDIANS**, North American Indian tribe originally inhabiting the region in the vicinity of Flathead Lake and Flathead R., in what is now northwestern Montana. The name Flatheads was given to the Salish by other Indian tribes along the Columbia R. to the west, who compressed the heads of their babies into a peak by means of a cone-shaped wicker headpiece. By contrast the heads of the Salish, which were normal in shape, had a flat appearance. Although not warlike, the Salish defended themselves with great bravery against their enemies, the Blackfoot (q.v.) Indians. In 1885, after ceding their land by treaty to the United States, the Salish, the Kutenai, and the Upper Pend d'Oreille Indians were placed on reservations in northwestern Montana. See SALISHAN FAMILY.

The name Flathead has been applied also to several Indian tribes that actually practiced head-flattening: the Chinook of Oregon and Washington, and the Catawba, Chocktaw, and Waxhaw of the southern U.S. See AMERICAN INDIAN LANGUAGES; AMERICAN INDIANS: *North Pacific Coast Area* and *Plateau Area*.

FLATHEAD LAKE. See MONTANA: *The Land: Rivers and Lakes*.

FLATTERY, CAPE. See CAPE FLATTERY.

FLATULENCE, presence of excessive amounts of gas in the stomach or intestines. Most of the gas present in the stomach consists of atmos-

FLATWORM

pheric nitrogen and oxygen that have been swallowed. The nitrogen is largely unabsorbable, and travels on through the intestines. Additional gases, principally carbon dioxide, methane, and hydrogen, are formed within the intestines. The carbon dioxide, produced by fermentation, is largely absorbed. The other gases, produced by incomplete digestion of foods rich in starch or cellulose, such as beans or cabbage, are eventually expelled from the rectum as flatus. The disagreeable odor of flatus is caused by several sulfur compounds, especially mercaptans. Large amounts of gas in the stomach or intestines may cause distention and pain.

FLATWORM, common name of a parasite, an invertebrate animal in the phylum Platyhelminthes. The flatworms are the most primitive group of multicellular animals that arise from three germ layers. All flatworms are bilaterally symmetrical and somewhat flattened, and most of them are elongated. Three main classes are included in this phylum: Cestoda (tapeworms), which in the adult stage are parasitic in the digestive tracts of animals; Trematoda (flukes), which are parasitic in various parts of different animals; and Turbellaria (planarians), which are free-living and nonparasitic. The Nemertinea, a group of unsegmented marine worms, are sometimes included among the Platyhelminthes. Other authorities consider them a separate phylum.

The ectoderm (outer surface) of the free-living flatworms is usually covered with cilia; in the parasitic forms the ectoderm usually secretes a noncellular, hardened material called *cuticle*. A well-developed musculature, found directly under the epidermis, allows the body to expand and contract, thus changing the body shape to a remarkable degree. Vivid pigmentation is sometimes present in the free-living forms, but the parasitic forms are usually unpigmented. Flatworms have no true body cavity; the spaces between the organs are filled with a compact connective tissue called *parenchyma*. One end of the body is usually more specifically adapted, or specialized, than the other end, and locomotion takes place in the direction of specialization. The oral and genital openings are on the ventral side. When present, the digestive tract is either saclike or branched and has only one opening. This opening may be equipped with a sucker, as in the flukes, or, as in most turbellarians, it may have a well-developed pharynx. The nervous system consists of a network with a large ganglion (brain) and various longitudinal nerve cords forming the principal parts. Sensory cilia and "eye spots" may be present in

the free-living forms and in the larvae of the parasitic forms. The flatworm has no blood or vascular system. Specialized cells possessing cilia, called flame cells, lead from the interior to one or more openings in the exterior by means of a network of tubes. Together these structures form the excretory system. The reproductive system is highly complex and occupies a large portion of the interior of the animal. Although flatworms are almost all hermaphroditic (both male and female reproductive organs are present in each individual), the eggs and sperm are formed separately. These germ cells either leave the body by separate openings or enter a common chamber, called the genital atrium.

Free-living flatworms are found in almost every kind of environment, on land and in fresh and salt water. These forms feed mainly upon small animals and plants. The parasitic flatworms often display a complicated life cycle, which may require development in four or five hosts before completion. See CESTODA; FLUKE; PARASITE; TAPEWORM.

FLAUBERT, Gustave (1821–80), French novelist, born in Rouen. He studied medicine but gave up that profession to devote himself to writing. His life, with the exception of several trips to the Orient and to North Africa, was uneventful. From 1846 until his death he lived in Croisset, a suburb of Rouen, where he was visited by many leading contemporary writers.

Flaubert's first and most widely read novel, *Madame Bovary*, first published in 1857, soon became a famous legal case. Both the author and the publisher were prosecuted on the grounds that the novel was immoral. Although they were acquitted, scandal clouded the reception of the novel, and it was some time before it won recognition as one of the masterpieces of French literature. It has appeared frequently in English. See FRENCH LITERATURE: *The Realists*.

Madame Bovary relates, against a French provincial-town background, the romantically motivated adulteries of a married woman whose pathetically overblown love affairs end in her suicide. In essence the novel is an indictment of the drabness, pretensions, and petty delusions of bourgeois life, which Flaubert loathed almost to the point of obsession. Nevertheless, the tragedy of the characters, mediocre and dull though they are, is portrayed with powerfully effective perception. *Madame Bovary* has had a lasting influence as a masterpiece of realism. See REALISM: *Realism in the Arts*.

Flaubert's other important novels are *Salammô* (1863; Eng. trans., 1964) and *La Tentation de Saint Antoine* (1874; Eng. trans., *The*



Gustave Flaubert

Bettmann Archive

Temptation of Saint Anthony, 1943). The former is a historical novel set in ancient Carthage; the latter is a retelling of the Christian legend of the temptations of the father of Christian monachism, Saint Anthony (q.v.), in the solitude of the desert. Although these two novels are generally regarded as more romantic in character than *Madame Bovary*, nearly all of Flaubert's writing combines significant naturalistic and romantic elements.

In his posthumously published letters *Correspondance* (4 vol., 1887–93), from which selections appeared in English in 1954, Flaubert attested to his experiencing “the agonies of art”. The infinite care which he practiced in order to achieve an ultimate precision of detail and of language has become legendary. Flaubert's devotion to art is nowhere more manifest than in the standard of perfection which he required of himself.

Other works by Flaubert include the novel *L'Éducation Sentimentale* (1869; Eng. trans., *Sentimental Education*, 1964); three short stories published as *Trois Contes* (1877; Eng. trans., *Three Tales*, 1964); and two posthumously published works, the unfinished novel *Bouvard et Pécuchet* (1881; Eng. trans., 1954) and the *Dictionnaire des Idées Reçues* (1913; Eng. trans., *Dictionary of Accepted Ideas*, 1954).

FLAX, plant of the genus *Linum*, grown extensively for its fiber and seed. The fiber products include linen threads and linen fabrics, and the seed is the source of linseed oil and linseed meal. The most important flax species in com-

merce is *L. usitatissimum*; other species of *Linum* are cultivated as ornamental plants or for pharmaceutical products.

Flax plants range in height from 12 to 40 in., and have shallow taproots. Because the stems contain the fiber, the taller varieties, which are sparsely branched, are used for fiber production. The seed-producing varieties have shorter stems and are more heavily branched. Both fiber and seed flaxes have narrow, alternate, lancelike leaves. Flowers are completely symmetrical, with five sepals, five petals, ten stamens, and up to ten seeds; the seeds are borne in five double-celled carpels. See FLOWER: *Parts of a Flower*. The flowers of most cultivated varieties range in color from deep to pale shades of blue. Some varieties, which may have white, violet, pink, or red blossoms, make very effective ornamental plants. Flaxseeds are shiny and may be dark brown, yellow, or mottled in color.

Origin. The use of flax fiber for cloth originated in the Stone Age, almost 10,000 years ago. Remnants of linen fishing nets and clothing and unworked flax have been found in Switzerland in the remains of lake dwellings of the Stone Age. The ancient Egyptians used linen shrouds, some of which are still preserved on mummies. Pictures of flax cultivation adorn the walls of various Egyptian tombs. Passages in the Bible refer to the manufacture of linen. Annual flax, which was cultivated in Mesopotamia, Assyria, and Egypt for about 5000 years, still grows wild in the regions around the Persian Gulf, the Caspian Sea, and the Black Sea.

In America flax was grown as early as 1626, and linen was the most important textile fiber until the start of the industrial revolution (q.v.). With the invention of the cotton gin in 1793, cotton became a very cheap raw material, and it largely displaced flax as a fiber source. Subsequently flax has been cultivated in the United States mainly for its seed.

Fiber Flax. Primarily a temperate-region plant, flax grows under a wide range of temperature and moisture conditions. High temperatures and high precipitation are, however, unfavorable for production of either flax fiber or seed. Moderately fertile silt or clay loams are most satisfactory for cultivation of high-quality fiber plants.

Fiber flax is harvested by uprooting the plants, which then are piled in the field to dry. The seed is removed to be used for feed or oilseed or to be retained for planting. The straw is retted, a process which promotes partial decomposition of the stem to permit separation of the fiber from the woody portions. In retting, the



Flax, Linum usitatissimum

American Museum
of Natural History

straw is spread on the ground in order to subject it to the action of rain and dew, and of microorganisms, and to cyclic wetting, drying, freezing, and thawing. Another process, called water-retting, that is used in some countries, consists of immersing the straw in ponds, streams, or specially designed tanks, in which water and microorganisms promote decomposition.

The retted stems are crushed and broken and the fiber is separated from the woody fragments, called shives. This process yields the relatively long and straight fibers, known as line fibers, and the short, damaged or tangled fibers, called tow. The line fiber is used for many products, including threads, laces, twines, and various types of fabrics. Flax tow is used primarily in upholstery.

Having high tensile strength, flax fibers are utilized in the manufacture of various threads employed in the bookbinding and shoe industries and in such products as twines and fish nets. Flax fibers are used extensively also in various types of linen cloth. Linen garments, which give a sensation of coolness when worn, are preferred to cotton clothes in tropical countries. Because linen absorbs large quantities of moisture, it is ideal for use in towels and handkerchiefs.

France, Belgium, and the Netherlands produce great amounts of high-quality fiber. Flax fiber is produced on a limited scale in Ireland and Canada. Small acreages of fiber flax have been cultivated in the U.S., primarily in Michigan and Oregon, but there was very little commercial production of flax fiber after 1950. The Soviet Union cultivates an extensive acreage with a large total yield, but the quality of the fiber usually is inferior to that obtained from western Europe.

Total world production of fiber flax was relatively steady between 1956 and 1968, the total increase in this period being only about 10 percent. Only 16 percent of the flax fiber in the world is produced in non-Communist countries, and their share is declining. Total world production in the 1967-68 season was 1,548,000,000 lb. A similar difference exists in home consumption of linen products per capita. In 1966, the most recent year for which figures are available, per capita consumption of linen products in the U.S.S.R. was 3¾ lb.; in Poland it was almost 4¼ lb. On the other hand, consumption per capita in Australia, France, Italy, Sweden, and Great Britain ranged from just over ½ lb. to 1½ lb. In the U.S. it was less than ¼ lb.

Seed Flax. Flax for seed is produced and harvested in about the same manner as wheat and other small grains. The crop is most productive on loamy soils with moderate to high fertility. In California, India, and Argentina, seed flax is planted in the fall and matures in about 150 days. In the northern U.S. and in Canada and the northern latitudes in Europe, the crop is seeded in the spring and matures in 100 to 120 days. Yields and quality are best in relatively cool climates. High temperatures and drought during the time the seed is developing often reduce the crop yield and oil content and adversely affect the drying quality of the oil.

Seed flax does not compete well with weeds. It is planted on clean, firm seedbeds, usually on acreage previously planted to corn or similar intertilled crop in which weeds have been killed by cultivation. The inability of seed flax to compete with weeds or with other plants has made it valuable as a so-called nurse crop, or companion crop, for plantings of alfalfa, clovers, and other forage legumes. Weeds in the flax crop may be controlled by use of suitable herbicide sprays.

In the U.S., Canada, India, and Argentina, flax is grown primarily for its seed, which yields from 30 to 40 percent linseed oil by weight. The oil is used in the manufacture of paints, varnishes, linoleum, oilcloth, printing inks, soaps,

and many other products. Since 1959 it has been used also as a coating for concrete pavements and bridge decks to prevent scaling and surface deterioration from heavy traffic, from freeze-thaw cycles, and from applications of salt or calcium chloride for snow and ice control.

The oil cake, or linseed meal, which remains after the oil has been expressed, contains 30 to 40 percent crude protein and is a valuable feed for livestock.

In recent years the fiber from seed flax has been used in the manufacture of high-grade and special-purpose papers. A major portion of U.S. cigarette paper now is manufactured from domestic sources of the material.

In the 1968-70 period the U.S. planted an average of 2,500,000 acres of flax per year, about 95 percent of it in North Dakota, South Dakota, and Minnesota. Annual U.S. production in that period averaged 30,714,000 bu. The U.S. flax acreage was sharply reduced in 1971 and 1972. Other leading flax-producing countries in the 1968-70 period were Canada (32,053,000 bu.), Argentina (25,064,000 bu.), the Soviet Union (19,697,000 bu.), and India (15,511,000 bu.).

A.H.MO.

FLAXMAN, John (1755-1826), British sculptor and illustrator, born in York, England. He studied clay modeling and drawing at the school of the Royal Academy, London. From 1775 to 1787 he was employed by the noted British potter Josiah Wedgwood (q.v.) in making decorations in relief for the vases, cups, and other forms of pottery manufactured by Wedgwood. Flaxman's reliefs were modeled on Greek and Pompeian pottery ware, and were delicate and balanced in design. His work was principally responsible for the great popularity of Wedgwood ware. From 1787 to 1794 Flaxman studied and worked in Rome. During this period and somewhat later he executed his best-known artistic work, the series of outline illustrations for the *Iliad* and *Odyssey* (qq.v.) by the Greek epic poet Homer, for the plays of the Greek dramatist Aeschylus, for *The Divine Comedy* (q.v.), by the Italian poet Dante Alighieri, and for the poems of the Greek poet Hesiod (q.v.). He returned to England in 1794 and continued his work as a sculptor. He became a member of the Royal Academy in 1800, and in 1810 became first professor of sculpture at the school of the academy. Among his sculptures are the monuments to such notable Englishmen as the painter Sir Joshua Reynolds and the statesman and general Charles Cornwallis, 1st Marquis Cornwallis (qq.v.). Casts of Flaxman's principal sculptures are in a collection in University College, London. Collections

of his drawings, including both outline illustrations and studies, are in University College, the British Museum, the South Kensington Museum, all in London, and in the Fitzwilliam Museum, Cambridge.

FLAX, NEW ZEALAND, plant of the genus *Phormium* of the Lily family Liliaceae, or the fiber obtained from this plant. New Zealand flax fiber is obtained from the leaf of a monocotyledonous plant, *P. tenax*, whereas the common flax fiber is obtained from the stem of a dicotyledonous plant. The New Zealand flax plant is an evergreen that grows wild over large areas, and is easily cultivated even in poor soil. Although the plant was originally cultivated in New Zealand, it has been introduced into Australia and southern France. In the United States it is used as a decorative plant in greenhouses and gardens. The leaves, resembling those of an iris, are about 2 to 8 ft. long, and up to about 8 in. broad, and may contain as much as one fifth fibrous material. To obtain the fiber the leaves are cut off, the nonfibrous material is scraped away, and the fiber is combed and cleaned in a manner similar to the treatment of common flax. New Zealand flax fibers are long, white, soft, slender, pliable, and very strong. Their length may exceed 4 ft. They are used mainly in ropes, twines, mattings, cordage, and often in combination with other cord fibers, for example sisal, in the manufacture of exceptionally strong ropes. The fiber is also used in the production of a fine cloth similar to linen duck.

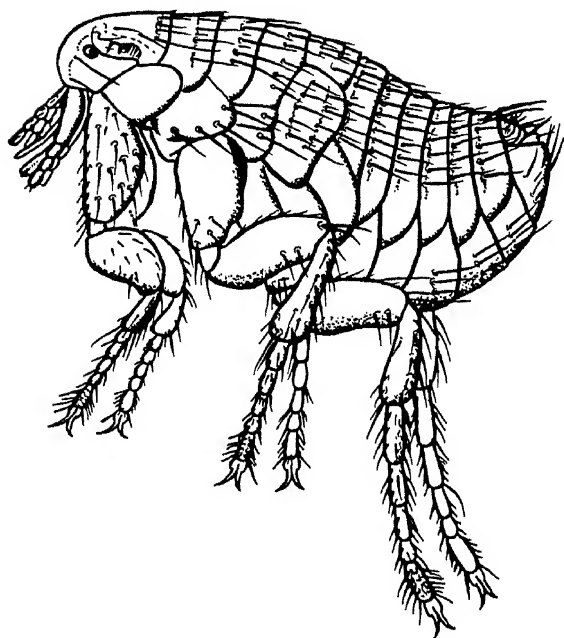
F LAYER. See IONOSPHERE.

FLEA, small, bloodsucking, wingless insect belonging to the order Siphonaptera (Aphaniptera). Fleas, which feed entirely on the blood of their hosts, are surface parasites on the skin of man and other mammals, and less often, on birds. Lice resemble fleas in habits and appearance and are sometimes confused with fleas; however, they belong to a different order (Anoplura), and unlike fleas, do not pass through a complete metamorphosis. Fleas are found in all parts of the world. Their eggs are laid under carpets, in the folds of tapestry, in refuse piles, and in other places which provide safety and adequate nutrition. In six to twelve days the eggs hatch, becoming larvae with biting mouth parts. After a few days of voracious feeding upon organic refuse, the larvae spin silk cocoons and enter a pupal stage. The adult flea emerges from the pupal cocoon in a few weeks. Adult fleas, which are slightly more than $\frac{1}{4}$ in. long, have broad, rather flat bodies, short antennae, and piercing and sucking mouth parts; their eyes are either minute or altogether lacking. Their long,

FLEA

powerful legs enable them to leap high into the air.

Certain kinds of fleas, usually imported from the U.S.S.R., may be trained to perform various feats, such as jumping through hoops, juggling, and pulling objects several hundred times their own weight. At the beginning of their training period a fine silk thread is tied around the neck of each flea. Because these insects are small, training is usually done with the aid of a magnifying glass. Before they can be trained to do any particular feat, the fleas must be trained to walk without jumping. The training is accomplished by various methods, all designed to frustrate attempts to escape.



Dog flea, *Ctenocephalides canis*

Several species of fleas infest household pets and domestic animals. *Ctenocephalides canis*, the dog flea, and *C. felis*, the cat flea, are two of the most common species, both of which are parasites also on human beings, poultry, and livestock. *Pulex irritans*, or human flea, the species known most often to attack man, is distributed throughout the world, but is uncommon in the United States. The dog flea, cat flea, and human flea are all intermediate hosts of the dog tapeworm. Tapeworm (q.v.) eggs are deposited in fecal matter, and some of these eggs may cling to the hair of the primary host. Fleas swallow the eggs, which then undergo some development in the flea. If an animal or person accidentally swallows an infected flea, an adult tapeworm develops in the new host. The rat

flea, *Xenopsylla cheopis* in the tropics and *Ceratophyllus fasciatus* in Europe, are important carriers of bubonic plague. The sticktight flea, *Echidnophaga gallinacea*, is another common pest, noted for its habit of clinging tenaciously to its poultry, dog, cat, or human host. Dog eczema is usually associated with the presence of fleas.

Fleas are controlled by destroying the adults and making breeding places unsuitable for larval life. Adult fleas are destroyed by bathing the host with strong soap, and by applying insecticides (q.v.) or petroleum. These agents must be properly used in order to avoid injury to the infected animal or person. Creosote oil, naphthalene flakes, and pyrethrum powder may be used to clean out the breeding places of fleas. See ENTOMOLOGY, MEDICAL; LOUSE.

FLEABANE, common name of several members of the family Carduaceae that emit an odor thought to drive away fleas and other insects. In the United States the most common fleabanes are *Erigeron annuus* and *E. strigosus*, the daisy fleabanes. In both species disk flowers are yel-



Daisy fleabane, *Erigeron annuus*

low and ray flowers white, giving the appearance of small daisies. Common in waste places, they are about 4 to 30 in. high at maturity, and have stout stems bearing sharply toothed, oval- or lance-shaped leaves.

FLEET. See MERCHANT MARINE OF THE UNITED STATES; UNITED STATES NAVY.

FLÉMALLE, LE MAÎTRE DE (Fr., "the Master of Flémalle"), name given to a 15th-century Flemish painter of the school of Tournai whose identity was for a long time uncertain. The name was derived from the Abbey of Flémalle, near Liège, whence came the three panels of an altarpiece by this painter. Various authorities identified the artist who executed these panels with three different painters. Rogier van der Weyden (q.v.), Robert Campin (1375?–1444), and Jacques Daret (140?–about 1468). Modern scholars have established that Le Maître de Flémalle was Campin, and that both Daret and Van der Weyden, to whom many of Campin's paintings were once ascribed, were his pupils.

Little is known of Campin's life except that at some time between 1406 and 1444 the town council of Tournai commissioned him to do decorative work, and that Daret and Van der Weyden became his pupils in 1427. Campin, after his contemporaries Hubert and Jan van Eyck (see *under* EYCK), was the outstanding Flemish painter of the time. His work is characterized by naïveté and sincerity. His figures and landscapes, in contrast to the realistic paintings of the Van Eycks, have a stiff, archaic quality.

FLEMING, Sir Alexander (1881–1955), British bacteriologist, born near Darvel, Scotland, and educated at Saint Mary's Hospital Medical School of the University of London. He served as professor of bacteriology at St. Mary's Hospital Medical School from 1928 to 1948, when he became professor emeritus.

Fleming conducted outstanding research in bacteriology, chemotherapy, and immunology. In 1922 he discovered lysozyme, an antiseptic found in tears, body secretions, albumen, and certain fish plants. He is best known as the discoverer of penicillin (q.v.), which he encountered accidentally in 1928 in the course of research on influenza. His observation that the mold contaminating one of his culture plates had destroyed the bacteria laid the basis for the development of penicillin therapy; see ANTIBIOTIC.

Fleming was knighted in 1944. In 1945 he shared the Nobel Prize in medicine and physiology with the British scientists Sir Howard Walter Florey and Ernest Boris Chain (qq.v.).

FLEMISH ART AND ARCHITECTURE

FLEMING, Sir John Ambrose (1849–1934), British physicist and electrical engineer, born in Lancaster, England, and educated at the universities of London and Cambridge. Fleming was professor of electrical engineering at the University of London from 1885 to 1926. He made contributions to electrical engineering in the fields of electric lighting, telephony, and wireless telephony. In 1904 he developed the Fleming valve, a triode tube which was the first device to amplify an electric current electronically; see ELECTRONICS. He was knighted in 1929.

FLEMING, Sir Sandford (1827–1915), Canadian civil engineer, born in Kirkcaldy, Scotland. In 1845 he emigrated to Canada, where he became chief engineer of the Northern Railway twelve years later. From 1867 to 1871 he was chief engineer in charge of construction for the Intercolonial Railway spanning Canada from the Atlantic to the Pacific oceans. He is primarily known for bringing about the introduction of the 24-hour-day system in railroad schedules. In 1879 his suggestion that the world be divided up into time zones found quick acceptance in the United States and Canada; see TIME, STANDARD. In 1897 he was knighted.

FLEMISH ART AND ARCHITECTURE, painting, sculpture, decorative arts, and architecture produced in Flanders (q.v.), a historic region in northwestern Europe now forming part of Belgium, the Netherlands, and France. Through

Sir Alexander Fleming

British Information Services





Detail from the 14th-century painting "The Adoration of the Lamb" by Hubert and Jan van Eyck. Belgian National Tourist Office

most of the Middle Ages (q.v.), Flanders, bordering along the North Sea, was an extremely prosperous territory. The great Flemish cities were important manufacturing and trade centers, and most aspects of town life, social, religious, political, and industrial, were under guild (q.v.) control. Until about the 15th century, when influences from southern Europe and the New World first began to penetrate, the artistic output of Flanders was virtually indistinguishable from that of the Dutch. From the 15th through the 17th centuries, however, Flanders ranked as a significant, even influential, art-producing state in its own right; the article deals primarily with this period. Art and architecture of the modern era are discussed in the articles on Belgium, the Netherlands, and France.

Painting. A distinctive Flemish school of painting emerged with the brothers Hubert and Jan van Eyck (q.v.) in the 15th century. The brothers improved the techniques of oil painting with such vivid results that their methods spread throughout Europe, supplanting almost everywhere the old tempera processes; see OIL PAINTING; TEMPERA PAINTING. Among the van Eyck masterpieces is the elaborate folding altarpiece in the Church of Saint Bavon in Ghent; known as the "Ghent Altarpiece" (1425?-1429?), its religious content placed it well within the medieval art tradition. The works of the van Eyck brothers represent the rise and development to maturity of the art of Flemish painting.

After the Van Eycks, all painting in northern Europe was dominated by the Flemish school

FLEMISH ART AND ARCHITECTURE



"Portrait of a Man" painted by Dierik Bouts in the 15th century.

Metropolitan Museum of Art—Bequest of Benjamin Altman

for nearly a hundred years. Rogier van der Weyden carried on the tradition of the van Eycks in superb paintings such as the "Descent from the Cross" (about 1435, Prado Museum, Madrid) and probably himself influenced Dierik Bouts, two of whose known works are a series of five panels (1464–68, Saint Peter's, Louvain, Belgium), and a portrait, believed to be of himself (Metropolitan Museum of Art, New York City). Another outstanding 15th-century Flemish painter was Hans Memling who painted mostly religious scenes of a calm delicacy. His most important works include "The Seven Sorrows of the Virgin" (Turin Museum) and "The Marriage of Saint Catherine" (1479, Hospital of Saint John, Bruges).

Memling's artistic heir, Gerard David, painted both religious subjects and landscapes. Among David's sacred compositions are "Madonna with Angels and Saints" (1509, Rouen) and "The Marriage of Saint Catherine" (National Gallery, London). Also of this generation of Flemish painters are Hieronymus Bosch, known for his realistically executed grotesque creatures, as in "Temptation of Saint Anthony" (Ayuda, Lisbon); and Simon Marmion (1425–98), distinguished as a great miniaturist, his chief work being the twelve-panel "Saint Bertin

Altarpiece" (1459, National Gallery, London).

Early in the 16th century the center of Flemish art moved from Bruges to Antwerp under the influence of Quentin Massys, painter of Biblical and genre pictures and of portraits. His works evidenced the first Italian Renaissance ideas in Flemish art. Among his notable paintings is "Lamentation of Christ" (1511, Antwerp Gallery). Pieter Brueghel the Elder, in his "Hunters in the Snow" (1565, Kunsthistorisches Museum, Vienna), shows the assimilation of Italian influence, particularly in the organization of his figures, and "The Wedding Dance" (Detroit Institute of Arts) is an admirable example of his dexterity in handling a crowded scene. Brueghel's sons and grandsons continued admirably in his tradition well into the 17th century. Jan Brueghel the Elder, the younger son of Pieter, was much admired by his contemporaries for the detailed style with which he executed still-life and landscape paintings.

In the 17th century, still in Antwerp, the chief figure was Peter Paul Rubens, an energetic exponent of the baroque, a style marked by elaborate ornamentation. Rubens' paintings typically exhibited light hitting sensuous flesh, rich textures, and a vivid, unrefined effect. His prolific output includes such famous works as "Peace and War" (National Gallery, London) and "Descent from the Cross" (1611–14, Ant-

"December Labors at the Inn", from an early 16th-century Book of Hours.

Pierpont Morgan Library





Painting by Peter Paul Rubens, entitled "Coronation of Marie de Médicis", shows all the characteristics of 17th-century baroque.

Archives Photographiques, Paris

werp Cathedral), usually regarded as his masterpiece.

Rubens' principal pupil was the portrait painter Sir Anthony Vandyke. Noted for expressing his awareness of the sitter's individuality, Vandyke completed a large number of fine portraits in Italy, Flanders, and England. During his early period he painted with the dark tones popular in Italy; later he turned to using cooler tones, exhibiting airiness and delicacy. Jakob Jordaens, David Teniers the Elder, and David Teniers the Younger, were also prominent representatives of the Flemish school of painters in the 17th century. The school declined in importance during the succeeding centuries.

Sculpture and Architecture. In the 15th century the Flemish produced some of the most important sepulchral sculpture in Europe. The "Monument to Isabella de Bourbon" (Antwerp) and the "Tomb of Louis de Male" (Lille) show the preoccupation with elaborate detail and expression of personality by their anonymous sculptors.

The history of Flemish architecture begins early, with churches erected in Flanders before the 12th century, and runs parallel with the general European development, especially that of France. Important Gothic buildings were erected in Brussels from 1227 on. One of the best specimens of pointed Gothic architecture extant is the Church of Saints Michael and Gudule in Brussels, begun about 1220. In 1352 work began on the Cathedral of Notre Dame in Ant-

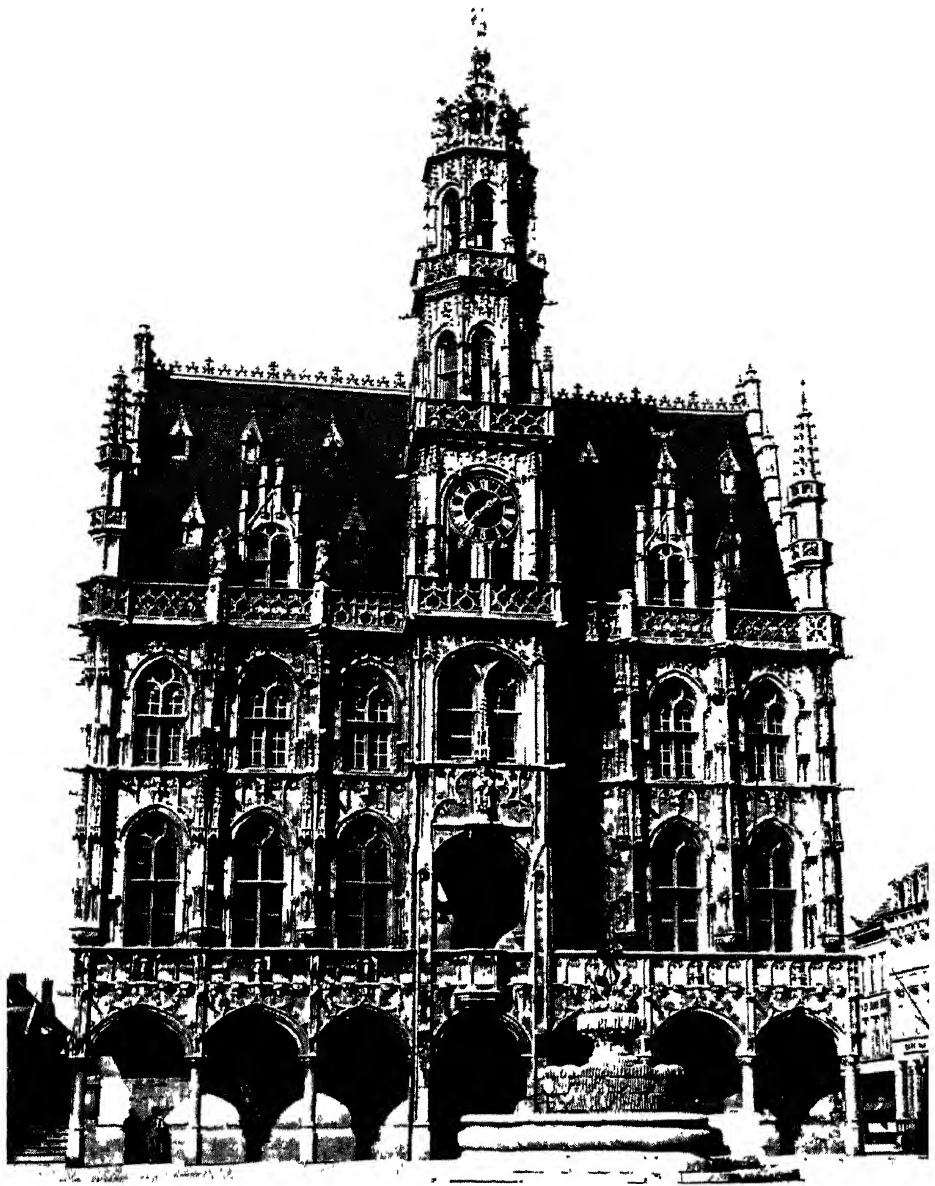
werp, and the edifice remains one of the finest and largest examples of Gothic architecture in the region. Buildings in Mechelen and Louvain date from about the same period. Many famous town halls, including the one in Mons, were built about the time of the influx of Renaissance architecture from Italy. The new architecture, characterized by a revival of ornamentation and classic shapes, as domes, columns, and rounded arches, was finally to replace the Gothic style. Later, Flemish architecture was devoted primarily to building that was pleasant but not particularly innovative.

Minor Art Forms. In the minor art forms the Flemish were remarkable for their accomplishments in the making of lace and tapestry and in engraving.

Little is known of the early history of lace making in the region. In the 15th century, its existence is evidenced by occasional depictions of lace as clothing ornamentation; for example, cuffs at the neck or wrists, worn by people appearing in paintings of the period. Lace making developed as an important industry in the 16th century. Craftsmen designed and executed elaborate lace pieces depicting personages and narratives as well as the more typical geometric and floral designs. Characteristic of Flemish lace at this time is a large coverlet (1599, Palais Cinquantenaire, Brussels) honoring a royal marriage and filled with lively people and scenes. See LACE.

The center of tapestry production moved from Paris to Flanders in the 15th century, with Antwerp, Bruges, Lille, Valenciennes, and Arras becoming important tapestry-making centers.

The town hall in Oudenaarde, Belgium, a noted example of late-Gothic Flemish architecture
 Belgian National Tourist Office



At first the pieces were simple and included scattered flowers and shrubs, sometimes with figures of people, animals, and birds. Later tapestries were more intricate with silhouettes, many figures, narrative detail, and delineation of facial expression. The Flemish tapestry makers achieved brilliant, lasting color effects as new dyes became available. Today, existing pieces from the period include the "Life of Saint Peter" (1460, Beauvais Cathedral). Of the Bruges school, dating from the early 16th century, is the "Lady with the Unicorn" series (Cluny Museum, Paris). Another notable series of Flemish tapestries is the "Acts of the Apostles" (Vatican, Rome) See TAPESTRY

The Flemish adopted the practice of print making about 1400, using wood blocks to print drawings on cloth and paper. A notably able

Flemish engraver was Gérard Edelinck (1640-1707) Edelinck executed more than 300 engravings, and in his interpretations of pictures and portraits by outstanding artists, he mastered the art of indicating light and shadow as well as surface textures. See ENGRAVING; WOOD ENGRAVINGS

See also separate articles for artists whose birth and death dates are not given.

FLEMISH LANGUAGE AND LITERATURE, language and literature of Flanders (q.v.), a historic region in northwestern Europe now forming part of Belgium, the Netherlands, and France The official Flemish-speaking provinces of modern-day Belgium, about 55 percent of the total population, are East Flanders Province, West Flanders Province, Antwerp Province, and Limburg Province, and the northern part of Brabant Province.

Development of a Written Language. The history of the Flemish language is entwined partially with that of the language spoken in the Netherlands; see DUTCH LANGUAGE; DUTCH LITERATURE. The oldest stage of the language is the dialect group called Old Low Franconian, which was spoken from the 7th to the 12th century by various Teutonic peoples in the lower Rhine region, from the confluence of the Ruhr and the Rhine rivers to the sea.

In the second half of the 12th century, and at the beginning of the 13th century, a written language began to develop out of the various dialect groups existing in the Netherlands and Flanders. Frisian was at first the principal dialect and was spoken along the coast and in the northernmost parts of the territory; see FRISIAN LANGUAGE AND LITERATURE. Saxon was used in the region near the lake IJsselmeer, and Franconian in the regions along the Rhine R. and in present-day Belgium. As far as can be ascertained, the first dialect to possess a written language was the Franconian of Limburg, in which Heinrich von Veldeke (fl. 1185), born near Maastricht (now in the Netherlands), wrote in the 12th century. Although all the poems of the following century exhibited local dialectic variations, they tended toward a common literary form, exemplified in the didactic writings of Jacob van Maerlant (1235?-1300). His popular moralizing works ranged over a wide variety of topics, including natural history, government, and the Bible. The original hegemony of the dialect of Flanders was challenged in the 15th and 16th centuries by that of Brabant (q.v.), because of the political and economic ascendancy of that province.

Influence of Political Events. Although many writers in the 16th century strove to make their own dialects the basis for a standard language, interesting attempts were made also to construe a general Netherlands language with elements from all dialects. The revolt of the Netherlands from about 1566 to 1648 caused the dialect of the province of Holland to dominate the growth of the standard language of the Netherlands. After the revolt had been suppressed in Flanders and Brabant, Holland became the leader of the independent Dutch Republic. Flemish and Brabant elements survived in the northern standard language, however, because of the important part taken by southern theologians in the northern Protestant Bible translation.

The Belgian provinces were separated from the northern provinces and remained under Spanish rule until 1714 when, by the Peace of Rastadt, they were awarded to Austria. During this entire period literature in the Belgian prov-

inces languished. In the late 18th century incipient signs of a literary revival developed. With the conquest and occupation of the Flemish provinces by the French in 1794, however, French became the official language. The union of Belgium with Holland in the Kingdom of the Netherlands in 1815 did not materially affect the Flemish and the French languages; the common people, supported by William I (q.v.), King of the Netherlands, clung to their local Flemish dialects, while the rich maintained their identity with the French-speaking peoples to the south. The revolution of 1830, which separated Belgium from the Netherlands, making it an independent state, seemed destined to destroy the Flemish language; only the spoken local dialects remained in use.

Literary Use of Flemish. In 1818, however, the Flemish scholar Jan Frans Willems (1793-1846) stated the value of Flemish in his dissertation *Verhandeling over de Nederduytsche Taal-en Letterkunde* ("Treatise on Low Dutch Philology and Literature"). His work started a movement which was encouraged by the government, but the 1830 revolution caused a temporary setback until the government, in 1836, commissioned Willems to prepare a text of the Middle Flemish poem *Van den Vos Reinaerde* ("Reynard the Fox"). After 1839 the movement spread rapidly, encouraged by poets such as Karel Lodewijk Ledeganck (1805-47), Theodor van Rijswijk (1811-49), and Prudens van Duyse (1804-59), and prose writers such as Hendrik Conscience (1812-83), who wrote more than a hundred novels and short stories in Flemish. The Belgian government, in the language laws of 1873, 1878, 1886, and 1897, aided the movement by finally making Flemish, with French, the legal and official language of the country, although French retained for a long time a privileged position. The Koninklijke Vlaamse Akademie (Royal Flemish Academy) was founded in 1886.

The Flemish language does not differ materially from the Dutch, but the three centuries of separation between the northern and southern Netherlands brought about differences which are readily recognizable, despite the unity in the spelling of Dutch and Flemish words. In addition to peculiarities of syntax and idiom, Flemish is particularly distinguished by the relatively large number of French elements incorporated into the language over the years.

The most important of the early Flemish novelists was Hendrik Conscience, whose *Jacob van Artevelde* was published in 1850. His works, portraying the struggle of the Flemish people against the Spanish, did much to promote na-

tional pride in the language. His contemporary, Jan van Beers (1821–88), was a Romantic poet, famous for his refinement and simplification of Flemish poetry. A number of novelists after Conscience, including Domien Sleetckx (1818–1901), August Snieders (1825–1904), and Virginie Loveling (1836–1923), reacted against the rural idealism that Conscience displayed in some of his novels; but, with the exception of the work of Loveling, their realism is weak. The most important Flemish poet of the 19th century was the priest Guido Gezelle (1830–99), whose simple and direct lyrical poems of religious feeling and rural life were little appreciated until after his death. One of those who discovered and praised Gezelle's poems was the symbolist poet Pol de Mont (1857–1931), who paved the way for the development of individualism in Flemish literature and the doctrine of art for art's sake.

Modern Flemish Literature. The monthly review *Van Nu en Straks* ("Today and Tomorrow"), founded in 1893, became the center of the first literary movement to counteract regionalism; its influence continued into the 1960's through two of its adherents, Herman Teirlinck (1879–1967) and Stijn Streuvels (pen name of Frank Lateur, 1871–1967). Teirlinck wrote novels, plays, and essays, and pursued wide-ranging interests in the arts; several of his books have been translated into English. Perhaps most influential were his plays *De Vertraagde Film* ("The Slow-Motion Film", 1921) and *Ik Dien* ("I Serve", 1924); the novel *Zelf-portret of Het Galgemaal* ("Self-Portrait, or the Convict's Last Meal", 1966), one of his last works; and his editorship (1946–67) of the humanistic review *Nieuw Vlaams Tijdschrift* ("New Flemish Review"). Probably the best novelist to come out of the *Van Nu en Straks* group is Streuvels, nephew of Guido Gezelle. Streuvels' large-scale descriptive tales deal with peasant life, the best known being *De Vlaschaard* ("The Flax Field", 1907). After World War II he published a memoir, *De Familie Gezelle* ("The Gezelle Family").

The poet Karel van de Woestijne (1879–1929), in direct contrast to Gezelle, made symbolist autobiography the core of his work; he influenced many younger writers and is considered among the most important modern Flemish poets. The poets of the next generation were concerned with the liberation of poetry from traditional forms. In the periodical *Ruimte* ("Space") was published the work of a group of young expressionists, led by Paul van Ostaïen (1896–1928), who followed the work of the German expressionists and in his later works that of the dadaists (see DADAISM). Associated with van Os-

taïen was Marnix Gijsen (pen name of Jan-Albert Goris, 1899–), probably the most distinguished Belgian expressionist poet to achieve prominence following World War I. A collection of his poetry was published in 1925. After World War II Gijsen turned to novel writing. Several of his largely autobiographical novels reflect the ambiguities of the position of the European intellectual in America: for example, *De Vleespoten van Egypte* ("The Fleshpots of Egypt", 1952). He collaborated on *Albrecht Dürer: Diary of His Journey to the Netherlands*, published in English in 1971.

The traditional type of Flemish novel, dealing with the countryside and the small town, found its strongest exponent in Felix Timmermans (1886–1947), particularly in his *Pallieter* (1916), whose hero stood for Flemish *joie de vivre* and became known through translation to English readers. Novelists of the same generation who broke from the traditional Flemish novel to explore the psychology and social situations of more urban experience include Willem Elsschot (1882–1960), Maurice Roelants (1895–1966), and Gerard Walschap (1898–). Works by Elsschot (*Three Novels*, 1965) and by Walschap (*Marriage and Ordeal*, both 1963) have been translated into English. The post-World War II generation has produced works of varying experimental hues; among the better-known writers are the novelists Hugo Raes (1929–), Ward Ruyslinck (1929–), and Hugo Claus (1929–), whose work also encompasses poetry and plays.

FLEMISH MUSIC. See MUSIC: *The Renaissance*.

FLENSBURG, city and seaport of West Germany, Schleswig-Holstein State, on the Danish border on an inlet of the Baltic Sea about 50 miles N.W. of Kiel. The city was founded about the 12th century, and received municipal rights in 1284. It was subject to a number of invasions by the Danes and the Swedes, and in 1848 became the capital of Schleswig under Danish control. In a plebiscite following World War I the inhabitants of Flensburg voted for inclusion in Germany. The principal public buildings in the city are its two medieval churches, the Marienkirche and the Nikolaikirche. Educational institutions include schools of marine engineering, navigation, agriculture, and woodcarving. Shipbuilding yards with large drydock facilities, sugar refineries, and rice mills are located in the city. Food processing, particularly the production of smoked fish, is important. During World War II Flensburg was an important submarine and naval base of the Germans, and suffered heavy aerial bombardment by the British. Fol-

FLESH FLY

lowing the war the city was included in the British Zone of Occupation. Pop. (1971 est.) 95,000.

FLESH FLY or **MEAT FLY**, common name applied to any dipterous insects belonging to the family Sarcophagidae, the larval forms of which are found in dung and carrion and in the living tissues of man and other animals. Flesh flies resemble large houseflies, and many of them are marked with longitudinal stripes on the thorax and abdomen. Most flesh flies lay eggs, but in a few species the eggs are retained in the abdomen of the female until they hatch. The larvae develop for about a day, then burrow in meat for a week to ten days before entering the two week pupal stage. *Sarcophaga* is the principal genus, and *S. sarraciniae* is a familiar pest in America. In Europe *S. carnaria* is a prevalent species. Parasitic flesh flies include several species of *Chrysomya*, most commonly found under the skin in man, and various species of the genus *Protocalliphora*, which are parasitic on young birds. See PARASITE.

FLETCHER, name of two English men of letters, known especially for their poetry.

Phineas Fletcher (1582–1650), born in Cranbrook, Kent, and educated at Eton College and King's College, University of Cambridge. In 1621 he was given the rectory of Hilgay, Norfolk, where he spent the rest of his life. In 1627 he wrote two poems, one in Latin and one in English, attacking the Jesuits. His chief work, *The Purple Island, or the Isle of Man* (1633), is an allegory written in Spenserian stanzas; see SPENSER, EDMUND. The principal appeal of his poetry lies in the charming descriptions of rural scenery. His peculiarities of style are more pronounced than those of his brother Giles Fletcher, but his verse is fluent and musical.

Giles Fletcher (1588?–1623), brother of Phineas, born in Cranbrook, Kent, and educated at Westminster School and Trinity College, University of Cambridge. He was famous for his sermons at Saint Mary's, Cambridge, and upon leaving the university he was appointed rector of Alderton on the Suffolk coast. Like his brother he was a disciple of the English poet Edmund Spenser, employing the Spenserian stanza. In 1603 he contributed a poem to *Sorrow's Joy*, a compilation of verse mourning the death of Elizabeth I (q.v.), Queen of England. His other works include the poems *Christ's Victory and Triumph in Heaven and Earth* (1610) and *The Reward of the Faithful* (1623).

FLETCHER, John. See BEAUMONT AND FLETCHER.

FLEUR-DE-LIS (Fr., "flower of the lily"), heraldic device used, notably, in the armorial bearings of the royal house of France. The origin of

the fleur-de-lis has been variously derived from an arrowhead, a spearhead, and, most commonly, from the flower of the iris, which accounts for its name. The device was used in ancient India and Egypt. During the reign of Louis VII (q.v.), King of France, the fleur-de-lis strewn on a blue shield became the official bearings of the royal house of France. Because of the esteem for French chivalry, the device was copied throughout Europe. In 1376, Charles V (q.v.), King of France, fixed the number of fleur-de-lis on the French arms as three in honor of the Trinity (q.v.). See FLOWERS, SYMBOLIC USE OF; HERALDRY.

FLEURY, André Hercule Cardinal de. See LOUIS XV.

FLEXNER, name of a distinguished American family.

Simon Flexner (1863–1946), pathologist and bacteriologist, born in Louisville, Ky., and educated in medicine at the University of Louisville, Johns Hopkins University, and in Europe. He taught pathology at Johns Hopkins University and at the University of Pennsylvania and in 1903 joined the staff of the Rockefeller Institute for Medical Research (now Rockefeller University). He was director of the institute from 1920 to 1935. In 1907 he achieved international acclaim for developing Flexner's serum to treat cerebrospinal meningitis. He is also known for his research in poliomyelitis (1909) and for discovering (1899) a bacillus that causes dysentery. With his son, the American writer James Thomas Flexner (1908–), he wrote *William Henry Welch and the Heroic Age of American Medicine* (1941).

Abraham Flexner (1866–1959), educator, brother of Simon, born in Louisville, Ky., and educated at Johns Hopkins University. He taught high school in Louisville from 1886 to 1905 and then completed his graduate studies at Harvard University and the University of Berlin. While in Europe he wrote his first book, *The American College: A Criticism* (1908). From 1908 to 1912 he was on the staff of the Carnegie Foundation for the Advancement of Teaching (q.v.). The foundation authorized his next two studies: *Medical Education in the United States and Canada* (1910) and *Medical Education in Europe* (1912). The texts prompted reforms in American medical training. Flexner, in 1913, joined another private foundation, the General Education Board (q.v.); he was assistant secretary (1913–17), secretary (1917–25), and director of the division of studies and medical education (1925–28). In 1928 he delivered the Taylorian lectures at the University of Oxford. Two years

later he became the first director of the newly formed Institute for Advanced Study (q.v.), a post he retained until 1939. His other writings include *Medical Education: A Comparative Study* (1925), *Universities: American, English, German* (1930), *I Remember: An Autobiography* (1940), and the biographies of several American educators.

Anne Crawford Flexner (1874–1955), playwright, wife of Abraham, born in Georgetown, Ky., and educated at Vassar College. Her plays include a dramatization in 1903 of *Mrs. Wiggs of the Cabbage Patch*, a novel by the American writer Alice Caldwell Hegan Rice (1870–1942), and *Aged 26* (1936), a play based on the life of the British poet John Keats (q.v.).

FLICKER, most common North American ground-dwelling woodpecker (q.v.), *Colaptes auratus*, ranging over the entire continent east of the Rocky Mountains. The flicker is a medium-sized bird, about 12 in. long. It has a black, crescent-shaped marking on its upper breast, a black stripe on each cheek, and a scarlet crescent on the nape of its neck; the olive-brown back is barred with black. The bird may be recognized by the bright yellow feathers covering the underside of the wings, by its white rump, and by its characteristic undulating flight. Like other woodpeckers, it nests in tree holes; it feeds chiefly on ants. Five to nine white eggs are laid in a clutch. The song of the flicker is varied,

but the most familiar is a clear, high-pitched note repeated from ten to twenty times.

The red-shafted flicker, *C. cafer*, found on the western seacoast and ranging eastward to the Rocky Mts., is much like the common flicker in appearance and habits; however, its wings are salmon red on the underside. Four other species are known.

FLIGHT, THEORY OF, generally, aerodynamic principles governing the flight of man-made, heavier-than-air craft, that is, airplanes; see AERODYNAMICS; AIRPLANE.

An airplane flies because air moving over and under its surfaces, particularly its wings, travels at different velocities, producing a difference in air pressure, low above the wing and high below it. The low pressure exerts a pulling influence, and the high pressure a pushing influence. The lifting force, usually called lift, depends on the shape, area, and tilt of the wing, and on the speed of the aircraft. The shape of the wing causes the air streaming above and below the wing to travel at different velocities. The greater distance over which the air must travel above the curved upper surface forces that air to move faster to keep pace with the air moving along the flat lower surface. According to Bernoulli's Principle (q.v.), it is this difference in air velocity that produces the difference in air pressure.

This phenomenon is illustrated in Figs. 1 through 5 on the next page.

Lift. Wing area influences lift; the more wing that is exposed to the air, the greater the lift. The up or down tilt of the wing, usually called its angle of attack, contributes to or detracts from lift. As a wing is tilted upward, that is, as its angle of attack is increased, its lift increases. The air passing over the top of an uptilted wing must travel a greater distance and thus produces a greater pressure differential between the upper and lower surfaces.

Aircraft speed has a great influence on lift. The faster the air moves over and under the surfaces of an airplane, the greater the pressure differential and, as a result, the greater the lift.

As an airplane flies on a level course, the lift contributed by the wing and other parts of the structure counterbalance the weight of the plane. Within certain limits, if the angle of attack is increased while the speed remains constant, the plane will rise. Decreasing the angle of attack, that is, tilting the wing downward, causes the plane to lose lift and to descend. An airplane will also climb from level flight if its speed is increased, and it will dive if its speed is decreased. Lift varies directly with speed.

Red-shafted flicker, *Colaptes cafer*

Allan D. Cruickshank—
National Audubon Society



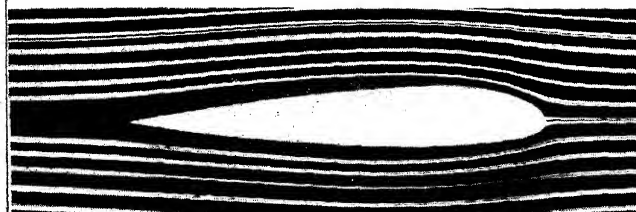


Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5

Changes in air flow occurring under various conditions of flight, providing greater or lesser lift with the different angles of attack.

During the course of a flight, a pilot frequently alters the speed and angle of attack of the aircraft. He often balances these two factors against each other. For instance, if he wishes to increase speed and yet maintain level flight, he must decrease the angle of attack to offset the extra lift provided by the increase in speed.

As a pilot prepares to land, he must ease the plane down and at the same time reduce its speed as much as possible. To compensate for the considerable loss of lift resulting from the decrease in speed, he provides lift by altering the wing area, effective curvature, and angle of attack. This is done through the use of flaps, which are large wing extensions located at each trailing edge. Most flaps are normally tucked into the wing during straight and level flight. When he wants extra lift, the pilot extends the flaps out and downward.

Drag. Factors that contribute to lift in airplane flight also contribute to undesirable forces called drag. Drag is the force that tends to retard the motion of the airplane through the air. Most drag is caused by the resistance of the air to objects moving through it. This type of drag can be reduced by streamlining the aircraft. It is also reduced by placing slots in the wing so that the boundary layer or "wall of air" building up in front and around the wing can flow through it.

One form of drag, however, known as induced drag, is a direct result of the lift produced by the wing. In effect, induced drag is the penalty exacted for lift. Great differences in the pressure of the air flowing over and under a wing can cause whirlpools or eddies of air to billow up along the trailing edges of the wings. These whirlpools produce a braking or rearward force that must be overcome by the forward thrust of the engines.

As the angle of attack of an airplane is increased, the plane gains lift, but only up to a point. As the angle of attack is increased, air turbulence spreads over the wing. Then at a certain critical point (an angle of about 14° in many airplanes), the wing loses lift and the plane stalls, nosing over into a dive.

Airplane designers try to design aircraft with high lift-to-drag ratios, that is, much more lift than drag. But they are limited by factors such as speed and the weight that the plane must carry. Faster planes usually have lower lift-to-drag ratios. A subsonic modern transport has a lift-to-drag ratio of about fifteen and a light private plane may have a lift-to-drag ratio of about twenty-five. A supersonic transport of the future, however, is expected to have a lift-to-drag ratio of no more than six.

Most of this discussion concerns subsonic flight. For a discussion of the special problems associated with flight faster than the speed of sound, see **SUPERSONICS**. See also **PROPELLER**; **WIND TUNNEL**

FLINDERS, Matthew (1774–1814), British explorer and navigator, born at Donington, Lincolnshire, England. A self-educated navigator, he sailed to New South Wales in 1795 and explored an unknown strait now known as Bass Strait between Australia and Van Diemen's Land (now Tasmania), which he circumnavigated to prove it was an island. On his return to England, in 1801 he took command of an expedition to investigate the coastline of Australia, which he circled in a counterclockwise direction, threading the Great Barrier Reef through what is now called Flinders Passage and surveying the Gulf of Carpentaria in the north. His charts of the coastline were remarkably accurate. His work completed in 1803, he sailed for England, was wrecked on an uncharted reef, and returned to Australia in the ship's cutter, a remarkable 700-mile journey. Setting sail in another vessel,

which was plagued by leaks, Flinders was forced to put in at Mauritius, then a possession of France, which was at war with England. Imprisoned for nine years as a spy, Flinders spent his time in recording the first method of compensating for compass deviations caused by iron in a ship. Broken in health, he was released in 1810, returned to England, and spent three years in writing *A Voyage to Terra Australis* (1814), published on the day of his death. The name of this outstanding hydrographer is perpetuated in a river in Queensland, several islands, a mountain range, and a naval depot near Melbourne. His consistent use of the term Australia led to acceptance of the name.

FLINDERS PETRIE, Sir William Matthew. See **PETRIE, SIR WILLIAM MATTHEW FLINDERS**.

FLINT, common massive variety of quartz (q.v.), having a dull, usually dark color. It is often found in the form of nodules in chalk deposits. Highest quality flint is taken from the coastal chalk deposits of Great Britain and northern France, and poorer grades occur in the Cretaceous limestones of the United States and

Flint, a dull variety of chalcedony (quartz), has been used by man for many purposes, two of which are illustrated here. The pointed hand ax (above), found in Egypt, is thousands of years old. Primitive man used flint for tools and for weapons such as knives and spearheads because he could shape it with relative ease by flaking off edges, applying pressure with a piece of bone or stone. A curious use of flint is represented by the flint nodules (below). Dredged up in the 1960's in the harbor of Stamford, Conn., they have been traced back to the famous White Cliffs of Dover, England. It is conjectured that they were brought over as ballast on English ships during Revolutionary War days and dropped overboard when they were no longer needed.



Katherine H. Jensen



Allen Blakeslee

FLINT

various other parts of the world. The presence of microscopic spines of sponges and shells of diatoms in flint suggests that these usually siliceous skeletal structures served as nuclei for the deposition of silica. Flint is a hydrated silica which, under certain conditions, appears to lose water at its surface, leaving a thin, porous coating or patina of white silica. On the new surfaces of freshly fractured fragments, the flint has a waxy luster.

Flint breaks with a conspicuous conchoidal fracture, producing sharp edges. Prehistoric man found fragments of flint useful for sharp weapons and cutting instruments such as ax-heads, arrowheads, and knives. When flint is struck with steel, sparks are readily produced; it was therefore extensively used in the past for igniting tinder and for firing gunpowder in flintlock arms.

Flint is principally used today as an ingredient of fine pottery. "Flints" used in cigarette lighters are an alloy of rare earth metals (see RARE EARTHS) and iron (misch metal), and have no relation to the quartz flint.

FLINT, city of Michigan and county seat of Genesee Co., on the Flint R., about 60 miles N.W. of Detroit. It is the second-largest automobile-manufacturing center in the United States, and the second-largest city in the State. Flint also produces paints and varnishes, bricks and tiles, chemicals, cotton and food products, and tents. It is the site of the Michigan School for the Deaf, a technological institute, a branch of the University of Michigan, and an art institute and academy. Flint was permanently settled in 1830 and was incorporated as a city in 1855. At first a fur-trading and then a lumbering center, the city became noted for the manufacture of horse-drawn vehicles many years before the establishment of the automobile industry there in 1904. Pop. (1960) 196,940; (1970) 193,317.

FLINT, one of the principal rivers of Georgia, rising near Atlanta in the Piedmont plateau. It flows s. and then s.w. for about 330 mi. and joins the Chattahoochee R. in the s.w. corner of the State on the border with Florida to form the Apalachicola R. The Flint is navigable for small boats s. from Albany. Power dams are located at Warwick, Albany, and at the junction with the Chattahoochee R.

FLINTLOCK. See SMALL ARMS.

FLINTSHIRE or **FLINT**, Great Britain, maritime county of N. Wales, bounded on the N. by Liverpool Bay, an arm of the Irish Sea, and on the E. by the estuary of the Dee R. Flint, the smallest county in Wales, is divided into two parts of the E. extremity of Denbighshire and the s.w. tip of

Cheshire. The coastline of Flint is regular, and the topography is dominated by the Clwydian Range, running in a northwesterly direction. The soil is extremely fertile in the vicinity of the Dee estuary. The principal crops raised are cereal grains, potatoes, and turnips. Dairy farming is important, and a large number of cattle and sheep are raised. The mineral deposits are extensive, and the mining industry produces coal, coarse clay, limestone, and iron and zinc ores. Smelters and steel, chemical, paper, wool, rayon, brick, and aircraft factories are the chief manufacturing establishments. The most important towns in Flintshire are the municipal borough of Flint, Rhyl, and Holywell. Mold is the county town. Area 256 sq.mi.; pop. (1971) 175,396.

FLODDEN or **FLODDEN FIELD**, Great Britain, plain in Northumberland, England, on the border with Scotland, at the base of Flodden hill, the N.E. continuation of the Cheviot Hills. The region is the site of a celebrated battle, in which a Scottish army commanded by James IV (q.v.), King of Scotland, was defeated on Sept. 9, 1513, by the English under Thomas Howard, 2nd Duke of Norfolk (see *under* HOWARD), chief lieutenant of Henry VIII (q.v.), King of England.

Upon Henry's refusal to accede to his demand to cease making war on France, an ally of Scotland, James raised an army of 100,000 and invaded England. By the time the Scottish army reached Flodden Field, it had dwindled to about 30,000 as a result of desertions. The opposing English army was of equal strength. By nightfall a decisive English victory was obvious. The total Scottish wounded and dead amounted to about 10,000; English losses were about 4000. Among the Scottish dead were King James, the Archbishop of Saint Andrew, twelve earls, and men from every important family in Scotland. The King's Stone, an unhewn granite pillar, is believed to mark the spot where James was killed. The battle is recreated in the sixth canto of the metrical romance, "Marmion, A Tale of Flodden Field", by the Scottish poet, Sir Walter Scott (q.v.).

FLOOD CONTROL, all methods used to prevent or reduce detrimental flood effects.

Causes of Floods. Floods begin when soil and vegetation cannot absorb rain or snow (qq.v.); water then runs off the land in quantities that cannot be carried in stream channels or retained in natural ponds and man-made reservoirs; see DAM. Some of the water is retained by the soil, some is absorbed by vegetation, some evaporates, and the remainder, which reaches stream channels, is called



Shasta Dam, on the upper Sacramento River in northern California, is one of the highest dams in the U.S. Besides reducing the threat of floods, the Shasta project provides electric power and irrigation for the area.
U.S. Bureau of Reclamation

runoff. About 30 percent of all precipitation is runoff, and the amount may be increased by melting snow masses. River floods result from excessive rain, sometimes combined with melting snow, causing the rivers to overflow their banks; a flood that rises and falls rapidly with little or no advance warning is called a flash flood. Flash floods usually result from intense rainfall over a relatively small area. Coastal areas are occasionally flooded by unusually high tides induced by severe winds over ocean surfaces, or by tidal waves caused by undersea earthquakes; see EARTHQUAKE.

Effects of Floods. Flood problems are diverse. Rapid runoff causes land erosion as well as sediment deposition problems downstream. Floods inundate property and endanger lives. High-velocity currents increase flood damage; prolonged high floods delay traffic and interfere with drainage and economic use of lands. Bridge abutments, bank lines, sewer outfalls, and other structures within floodways are impaired by floods; navigation and hydroelectric power are damaged. All of these problems result in large annual money losses.

Control of Floods. The basic methods of flood control have been practiced since ancient times. These methods include construction of levees, dams, and reservoirs, reforestation, and building of floodways (artificial channels that divert flood water).

The ancient Chinese built levees to raise the banks of the Hwang Ho on the supposition that

the confined river would then deepen its channel to contain the maximum flow. The result, however, was a raising of the river bed, because the sedimentary deposit of alluvial soil previously distributed over the entire flood plain was confined to the river bottom. In 4000 years the level of the river rose as high as 70 ft. above the surrounding plain. Levees were constructed during the Middle Ages on the Po, Danube, Rhine, Rhône, and Volga (qq.v.) rivers and have been supplemented in modern times by reforestation and by storage reservoirs. Levees are still in extensive use, notably on the Mississippi, where the river has been confined to a narrow channel to provide the depth necessary for navigation. To maintain that depth it has been necessary to dredge the channel repeatedly, adding to the already large cost of sustaining the levee system. Floods in the Mississippi valley have demonstrated that levees alone do not provide sufficient protection against flooding on a large river, and other methods of flood control, including dams and floodways, are now in use in the Mississippi R. system; see LEVEE

Although dams have been in use for many centuries, their primary purposes were to build up water reservoirs for irrigation and other domestic uses and to create power. Only recently have they been constructed specifically



At Oliver Springs, Tenn., a channel is deepened to increase its flow potential and reduce the danger of flooding.

Tennessee Valley Authority

for flood-control purposes. An effective method of controlling flood waters has been developed by the construction of coordinated groups of dams and reservoirs on the headwaters of the streams that lead into the main rivers, so that water can be stored during periods of heavy runoff and released gradually during dry seasons; see WATER SUPPLY AND WATERWORKS. The Hoover Dam on the Colorado R., the reservoirs in the Miami Conservancy District, and dams of the Tennessee Valley Authority (q.v.) have demonstrated the value of this method. In 1943, when extremely heavy precipitation threatened to cause a flood, the T.V.A. dams held the flood crest 6 to 8 ft. below the height that engineers estimated it would have reached if no regulation had existed. When the tributaries on which these dams are located are at their normal level, the dams operate solely to produce power and provide water for various purposes. During time of high water the dams operate to slow down the flow. The dams closest to the origins of the tributaries restrain the flood waters while the dams farther down slowly release their normal reservoirs and are drained. Then the flood waters are released to each succeeding dam, and are finally emptied into the main river, the capacity of which has been increased by straightening and deepening. Recent proposals have been made to extend this method of flood control to the Ohio, Missouri, Columbia, and Red (qq.v.) river systems.

Through the centuries man has created a

flood problem by cutting down trees and digging up the vegetable cover of the soil, thus increasing soil erosion. Cultivation decreases the retentive power of the soil and increases runoff. Vast land areas along the headwaters of rivers throughout the world have been laid waste by intensive cultivation and subsequent erosion. Flood control in these areas has been directed to a restoration of the vegetation and the institution of efficient methods of soil management in order to prevent recurrence of soil erosion and to reduce runoff. Soil management includes modern methods of scientific farming, such as crop rotation and contour plowing. Reforestation has the further advantage of retarding the melting of snow, thereby distributing runoff from that source over a longer period of time; see CONSERVATION; EROSION.

A fourth method of flood control is the construction of floodways on the lower reaches of rivers to divert flood waters. The rivers are widened at certain points and allowed to overflow. Inundation of certain confined areas prevents the flooding of other areas. The Egyptians have used regulated flooding for thousands of years. Many areas in the Nile Valley depend for their continued fertility on periodic flooding, because the soil deposited by sedimentation from flood water is very rich.

Flood-Control Legislation. In the 20th century the problem of flood control in the United States has assumed national importance due to the increasing frequency and intensity of floods in all of the great river valleys as a result of deforestation. In addition, agricultural and industrial development in these valleys has necessi-

FLOOD CONTROL

tated a coordinated program of flood control. Federal legislation has been passed to aid the States in effecting adequate control measures.

Federal action in this field was long hampered by many constitutional limitations. As late as 1879 the problem of Mississippi R. flood control was left to the thirty-one States in that river's drainage system. In that year, the Federal government, under the guise of improving navigation, a power constitutionally granted to it, helped finance the construction of levees. The Federal government has played an increasingly important role in the problem of flood control.

When scientific research into the causes of floods showed that the construction of levees was insufficient as a method of control, the first steps were made to provide for reforestation and soil conservation. The Clarke-McNary Act of 1924, the Mississippi Flood Control Act of 1928, and the McSweeney-McNary Act of the same year were all directed toward that end. In 1935 the Soil Conservation Service was established by Congress under an act declaring a policy of permanent provision for control and prevention of soil erosion, and for control of floods. In the same year, the Fulmer Act was passed, authorizing the secretary of agriculture to enter into cooperative agreements with the States for better forest-land management. In 1937, further authority was granted to the secretary of agriculture in the Bankhead-Jones Farm

Tenant Act to control soil erosion and to mitigate floods. Another act of Congress provided for an investigation of the material resources in the California watersheds. Similar acts covered the watersheds of the Rio Grande and Pecos (qq.v.) rivers. The period of the 1930's is notable for the many national forests that were established to assist in the soil-conservation program. The most important single act directed at the problem of flood control was the establishment of the T.V.A. in 1933.

By 1940, the United States Supreme Court had passed on the constitutionality of almost all Federal activities in the field of flood control, and had upheld actions that related to almost all waters of the U.S., without limiting these actions to the navigable streams, as had been done earlier. In the Flood Control Act of 1946, Congress authorized the construction of 123 projects designed to aid river regulation, flood control, and power development.

In 1972 Congress moved to reduce the hazards from the 28,000 non-Federal dams in the U.S. by passing a bill providing for a dam-inspection program estimated to cost \$90,000,000. The action was spurred by two disastrous dam failures during the year. At Buffalo Creek, W.Va., a makeshift dam at a coal mine site collapsed with a loss of more than 100 lives; and at Rapid

Contour farming in Jefferson County, Tenn. The practice prevents soil erosion and conserves rainwater, reducing the threat of floods. Tennessee Valley Authority



FLORA

City, S.Dak., two earth dams gave way, resulting in more than 200 deaths.

Many aspects of flood control can be handled by individual States or groups of States acting on a regional basis. One such project, completed in 1922, is the Miami Conservancy District, a Florida system of reservoirs that operate to reduce flood hazards.

Such organizations as the Los Angeles County Flood Control District, the T.V.A., and others relating to specific areas such as the Ohio, Connecticut, and Allegheny river valleys, have made important studies of hydrologic and meteorological conditions to aid in the forecasting of flood dangers and to plan flood control.

FLORA, in Roman mythology, goddess of flowers and springtime. Her festival, the *Floralia*, was licentious in spirit, and featured dramatic spectacles and animal hunts in the Circus Maximus (q.v.). Flora was represented in art as a beautiful maiden, wearing a crown of flowers.

FLORA AND FAUNA. See ANIMALS, GEOGRAPHIC DISTRIBUTION OF; PLANTS, GEOGRAPHIC DISTRIBUTION OF. For plants and animal life in the countries of the world and the States of the United States, see individual country or State.

FLORAL PARK, village of New York State, in Nassau Co., about 15 miles E. of Manhattan Island. Floral Park manufactures aircraft parts and photographic equipment. The cultivation of flowers, for which the village was named, is an important industry. Floral Park was incorporated in 1908. Pop. (1960) 17,499; (1970) 18,422.

FLORENCE, city of Alabama, and county seat of Lauderdale Co., on the Tennessee R. in the Muscle Shoals area, immediately w. of Wilson Dam, about 100 miles N.W. of Birmingham. It is served by air, rail, and river transportation. Florence is the largest city in an area that includes also Sheffield, Tuscumbia, and Muscle Shoals. In a poultry- and cattle-raising area, Florence is also the site of chemical, metallurgical, food-processing, and textile plants. Deposits of coal, iron ore, bauxite, and limestone are found in the environs. Florence State College, founded in 1872, is located in the city. Florence was chartered as a city in 1889. Pop. (1960) 31,649; (1970) 34,031.

FLORENCE, city in South Carolina, and county seat of Florence Co., about 70 miles N.E. of Columbia. It is an important railroad center and is the wholesale and retail distribution point for a trade area embracing eleven counties. Industrial establishments in the city include railroad and machine shops; plastics, electronics, and steel fabrication plants; bakeries; furniture factories; and textile mills. Florence is the center of a rich

agricultural area and the site of the Pee Dee agricultural experiment station, a national cemetery, and several hospitals. Florence was chartered in 1871 and incorporated in 1890. Pop. (1960) 24,722; (1970) 25,997.

FLORENCE (It. *Firenze*; anc. *Florentia*), city of Italy, in Tuscany Region, and capital of Florence Province, on the Arno R., 145 miles N.W. of Rome. The Arno divides the city into two sections. Florence is world famous for Gothic and Renaissance buildings, art galleries and museums, and parks; see GOTHIC ART; RENAISSANCE ART AND ARCHITECTURE. In addition, the city is an important commercial, transportation, and industrial center. It is a market for wine, olive oil, vegetables, fruits, and flowers, and lies on the railroad and main highway linking N. Italy and Rome. Manufactures include motorcycles, automotive parts, agricultural machinery, chemicals, fertilizers, plastics, and precision instruments. Florentine handicraft industries are traditional and famous, producing silverwork, jewelry, especially gold and cameos, straw work, leather goods, glass, pottery, wood carvings, furniture, and embroidery.

THE CITY

Seen from surrounding Tuscan hills, Florence presents a scene of unforgettable beauty.

Architectural Treasures. The city is dominated by the towers of its many palaces and churches and by the huge dome of the Cathedral of Santa Maria del Fiore. A Gothic structure with an exterior ornately decorated with red, green, and white marble, the cathedral was begun in 1296 by the Florentine architect Arnolfo di Cambio (1232?-1301?), continued on a somewhat different plan by his successors, and crowned with the great dome (1420-61), designed by Filippo Brunelleschi (q.v.). The facade, although not built until late in the 19th century, is faithful in style to the rest of the edifice. The cathedral is the most imposing structure on the right bank of the Arno. Beside the cathedral stands the 14th-century campanile, or bell tower (q.v.), which was begun by Giotto and continued by Andrea Pisano (qq.v.). Adorned with exquisite bas-reliefs, the campanile is perhaps the most beautiful in Italy. The octagonal baptistery of San Giovanni, facing the cathedral, dates mainly from the 11th to the 13th century, although some parts were built as early as the 5th century; it is noted for its doors of gilded bronze, especially the east door, called the Gate to Paradise, which was executed by the Florentine goldsmith Lorenzo Ghiberti (q.v.) and depicts sculpted scenes from the Old Testament.



Medieval and Renaissance Palaces and Sculpture. Nearby is the Bargello, or Palazzo del Podestà, a fortresslike building of the 13th and 14th centuries, which houses the National Museum. The latter has collections of enameled terra cottas by the della Robbia family (see *under* ROBBIA) and sculpture by Donatello (q.v.). The Piazza della Signoria, containing the Fountain of Neptune (1563–75), is dominated by the majestic Palazzo Vecchio, or Palazzo della Signoria, a rough and sturdy but pleasingly harmonious building surmounted by a crenellated 300-ft. tower. Built between 1298 and 1314, in 1550 this palace became the seat of the town council; later the Italian Chamber of Deputies met there from 1865 to 1871. The vast halls and state apartments are ornately decorated in the style of the late Renaissance. Opposite is the Loggia della Orcagna, also called Loggia dei Lanzi, a roofed structure open at the sides, which houses a number of statues, among them

Historic Florence, with the dome of the Cathedral of Santa Maria del Fiore and the Palazzo Vecchio just to the right of it.

Gianni Tortoli—Photo Researchers

the bronze "Perseus" by Benvenuto Cellini (q.v.) and the "Rape of the Sabines" by Giovanni da Bologna (see BOLOGNE, JEAN).

Art Galleries, Bridges, and Churches. Between the Palazzo Vecchio and the Arno stands the Palazzo degli Uffizi, built late in the 16th century to house government offices and law courts. Famous for its art gallery, the Uffizi Gallery, one of the finest in Europe, contains an unsurpassed collection of works by the greatest painters of Italy and a rich sampling of works by Flemish and French masters. The nearby Ponte Vecchio, which is lined with goldsmiths' and jewelers' shops, was built about 1350; it is the only bridge in Florence spared during World War II, and leads across the Arno to the Palazzo Pitti on the left bank. This building, begun in 1458 and subsequently much enlarged, was the

FLORENCE

residence of the grand dukes of Tuscany from 1550 to 1859. It contains another famous art collection, particularly rich in works by Andrea del Sarto, Raphael, Il Perugino, Titian, and Tintoretto (qq.v.). Behind the Pitti are the vast Boboli Gardens, used for outdoor concerts during the music festival held each year in May.

On the right bank of the Arno, in a kind of half-circle around the cathedral and the Palazzo Vecchio, are many famous churches and palaces. Noteworthy are the 13th-century Gothic Church of Santa Trinità, possessing a fine, luminous interior and a 16th-century baroque facade; and Santa Maria Novella (13th–15th cent.), with a colored marble facade and richly decorated cloisters, one of the most beautiful churches in the city. Eastward are the 15th-century church and cloisters of San Lorenzo, designed by Brunelleschi. The adjoining structure is the Medici Chapel, private chapel and burial place of the famous Medici (q.v.) family. Above the crypt of the Medici Chapel is the New Sacristy, for which Michelangelo (q.v.) was both architect and sculptor; the sacristy contains the tombs of Lorenzo II de' Medici, Duke of Urbino, with figures of "Dawn" and "Twilight"; and of Giuliano de' Medici, Duke of Nemours (1479–1516), with figures of "Day" and "Night".

The Palazzo Medici-Riccardi, built by Michelozzo (q.v.) for Cosimo de' Medici in the mid-15th century, faces San Lorenzo across a large piazza. Typical of the residences built by prominent families in this period, the ground floor is a private fort with a graceful courtyard, and handsome chambers occupy the upper stories. It houses the Medici Museum. A few streets to the N.E. is the former Dominican monastery of San Marco, also largely the work of Michelozzo. The structure is a museum in which are preserved the works of the two monks and painters Fra Angelico and Fra Bartolommeo as well as the cell once occupied by the preacher and reformer Girolamo Savonarola (qq.v.). Nearby are the Spedale degli Innocenti (founding home), with Brunelleschi's graceful portico decorated with ten of Andrea della Robbia's best-known blue and white terra-cotta medallions; the Gallery of the Academy of Fine Arts, housing many works of Michelangelo, including his "David"; and the Archeological Museum, with an outstanding Etruscan collection.

Southward, near the Arno, stands the handsome Franciscan Church of Santa Croce, built, except for a modern facade, in the 13th and 14th centuries. This church, with an interior of classic Franciscan simplicity and decorated with frescoes by Giotto and other masters, is called

the Pantheon of Florence because it contains the tombs of Michelangelo, statesman and political philosopher Niccolò Machiavelli, poet and dramatist Count Vittorio Alfieri, and operatic composer Gioacchino Antonio Rossini (qq.v.), and monuments to many other noted Italians. See FLORENTINE PAINTING AND SCULPTURE.

Libraries. One of the greatest libraries in Italy is located in Florence, the Biblioteca Nazionale Centrale (Central National Library), with approximately 3,000,000 books and pamphlets and many thousands of manuscripts, maps, and letters. Other libraries are the Laurentian Library, containing a priceless collection of books and manuscripts assembled by Cosimo, Piero (1414–1469), and Lorenzo de' Medici; the Marucelliana and Riccardiana libraries, which are rich in old letters, manuscripts, and prints; and the Moreniana, which is particularly important for local history. Thousands of documents pertaining to the history of Florence and Tuscany are preserved in the State Archives. The University of Florence, established in 1923, is the successor of an institution chartered in 1321. Florence is the seat also of a noted conservatory of music and of the Istituto Geografico Militare, which is world famous for fine mapmaking. See also FLORENTINE PAINTING AND SCULPTURE.

HISTORY

The ancient *Florentia* is believed to have originated as a small marketplace at the point where the Roman road called the Via Cassia crossed the Arno R. It flourished sufficiently as a Roman town to afford a sizable amphitheater and was a bishop's see in 313 A.D., but probably was not otherwise noteworthy. Florence is mentioned as the capital of a Lombard duchy in the 6th century, but little is known thereafter of its history until the 11th century, when it was again prosperous because of its position on the road from Rome to northern Italy.

Medieval Struggles and the Rise of the Republic. During the second half of this century Countess Matilda (1046–1115), who ruled Tuscany, employed the Florentines to combat feudal lords in the surrounding country, and the city, governed by a council composed of nobles and learned men, began to acquire a degree of independence. After Matilda's death Florence continued under the council, which nominally functioned in the name of the people, thus making the city a republic.

In 1125 Florence captured the nearby town of Fiesole and began its attempt to conquer all of the broad, fertile plain drained by the Arno. Internally the republic was divided by the struggle of its leading families for power. The struggle

originally was complicated to some extent by the great conflict between Guelphs and Ghibellines throughout Italy; see GUELPHS AND GHIBELLINES. Later civil war broke out in Florence between two Guelph factions, the Neri ("Blacks") and Bianchi ("Whites"). The poet Dante Alighieri (q.v.), one of the defeated Bianchi, was exiled from the city in 1302. Nevertheless, the city prospered. Industry, especially woolen-cloth manufacturing, and banking, through which many Florentines later amassed great fortunes, were added to an ever-expanding commerce. In addition, the organization of merchants and craftsmen into powerful guilds (see GUILD) gave the city an unexpected measure of stability. The wool guild, the richest of all, employed some 30,000 workers and owned 200 shops at the beginning of the 14th century. Merchants and bankers thus took a commanding lead in civic affairs and began to beautify the city. The republic warred repeatedly with Milan in the 14th and 15th centuries; in 1406 it finally acquired Pisa, downstream on the Arno, thus winning a long-coveted outlet to the sea.

Class Conflict, Flourishing Commerce, and Wealth. Considerable friction had developed meanwhile between the workers, who felt themselves exploited, and the wealthy classes. The conflict came to a head in 1433, when the aristocratic party exiled Cosimo de' Medici, wealthy merchant-banker and leader of the popular party. Cosimo returned in 1434, exiled his opponents, and in alliance with the poorer classes became the real ruler of the republic, although remaining nominally a private citizen. The Medici dominated the city, except for brief periods of exile, during the next three centuries. Cosimo was succeeded by his son Piero and his grandson Lorenzo de' Medici, known as Lorenzo the Magnificent, a great patron of learning and the arts. Lorenzo reduced the republican government to a shadow and by an ambitious foreign policy succeeded for a time in making Florence the balance of power among Italian states. The Florentine gold coin, the florin, became the standard of trade throughout Europe, and the commerce of Florence embraced the known world. The flowering of Renaissance art in architecture, painting, and sculpture, which made the name of Florence immortal, took place within little more than the span of the 15th century.

Lorenzo's son and successor, Pietro, made humiliating concessions to Charles VIII, King of France (see under CHARLES), who invaded Italy in 1494; in that year the outraged populace drove Pietro and his family from the city. Girolamo Sa-

vonarola, prior to the Dominican monastery of San Marco, emerged as the leading personality in Florence after Pietro's downfall. Savonarola, however, who had long inveighed against the luxury of Lorenzo's court, came into conflict with the pope and gradually lost popular favor. In 1498 he was seized by a mob, tried, and executed. The Medici, who had been returned to power by a Spanish army in 1512, were again exiled in 1527. On their reinstatement in 1531 the head of the family was given the hereditary title Duke of Florence by Holy Roman Emperor Charles V (q.v.). The title Grand Duke of Tuscany was bestowed on the head of the Medici family by Pope Pius V (see under PIUS) in 1569 and was confirmed by Maximilian II, Holy Roman Emperor (1527-76), in 1575.

Florence Since the Medici. The Medici ruled Tuscany until their line died out in 1737. They were succeeded by members of the imperial Austrian house of Hapsburg-Lorraine. Grand Duke Ferdinand III (1769-1824) was driven from his throne by the French in 1799 and restored in 1814. His successor, Leopold II (1824-59), expelled in 1849, returned with Austrian troops, but was finally deposed in 1859, during the struggle for Italian independence. Florence was the capital of Italy under King Victor Emmanuel II (see under VICTOR EMMANUEL) from 1865 to 1871, when Rome became the capital. In World War II most of Florence's monuments were not damaged, but all its bridges (except the Ponte Vecchio) were destroyed in 1944. In 1966 a major flood damaged numerous art treasures in Florence, but many were restored in succeeding years by the use of sophisticated techniques.

Population. Between 1961 and 1971 the population of the urban area increased from 411,795 to 461,602.

FLORENCE-GRAHAM, unincorporated area of California, in Los Angeles Co., 6 miles s. of downtown Los Angeles. Metal products and textiles are manufactured in the area. Pop. (1960) 38,164; (1970) 42,895.

FLORENCE, UNIVERSITY OF, autonomous coeducational institution of higher learning, located in Florence, Italy. The university is under the jurisdiction of the ministry of education and is supported by funds from the national government. The university was founded in 1321 by the Republic of Florence as a studium generale (university) and recognized by a bull issued by Pope Clement VI (1291?-1352) in 1349 and a royal decree of Charles IV, Holy Roman Emperor (see under CHARLES), in 1364. The institution was reorganized in 1859, became autonomous in 1872, and in 1923 was granted full university sta-

FLORENTINE PAINTING AND SCULPTURE

tus by the Italian government. The university includes the following faculties: law, letters and philosophy, political science, economics and commerce, education. There are also faculties of mathematics, physics and natural sciences, architecture, pharmacy, medicine, and agriculture. An institute of French studies and schools of statistics and midwifery are attached to the university. The degree of *laurea*, entitling the recipient to the honorific *dottore*, is awarded by all faculties after a four- to six-year course of study. The *laurea* is the approximate equivalent of an American degree of master. Post-*laurea* studies are offered by all faculties and lead to a higher specialized diploma after an additional period of study, normally two years in length. The library contains more than 1,537,000 bound volumes. In 1970–71 the student body numbered about 20,953 and the faculty, 194 professors.

FLORENTINE PAINTING AND SCULPTURE, the painting and sculpture produced in Florence, Italy, during the Renaissance (q.v.).

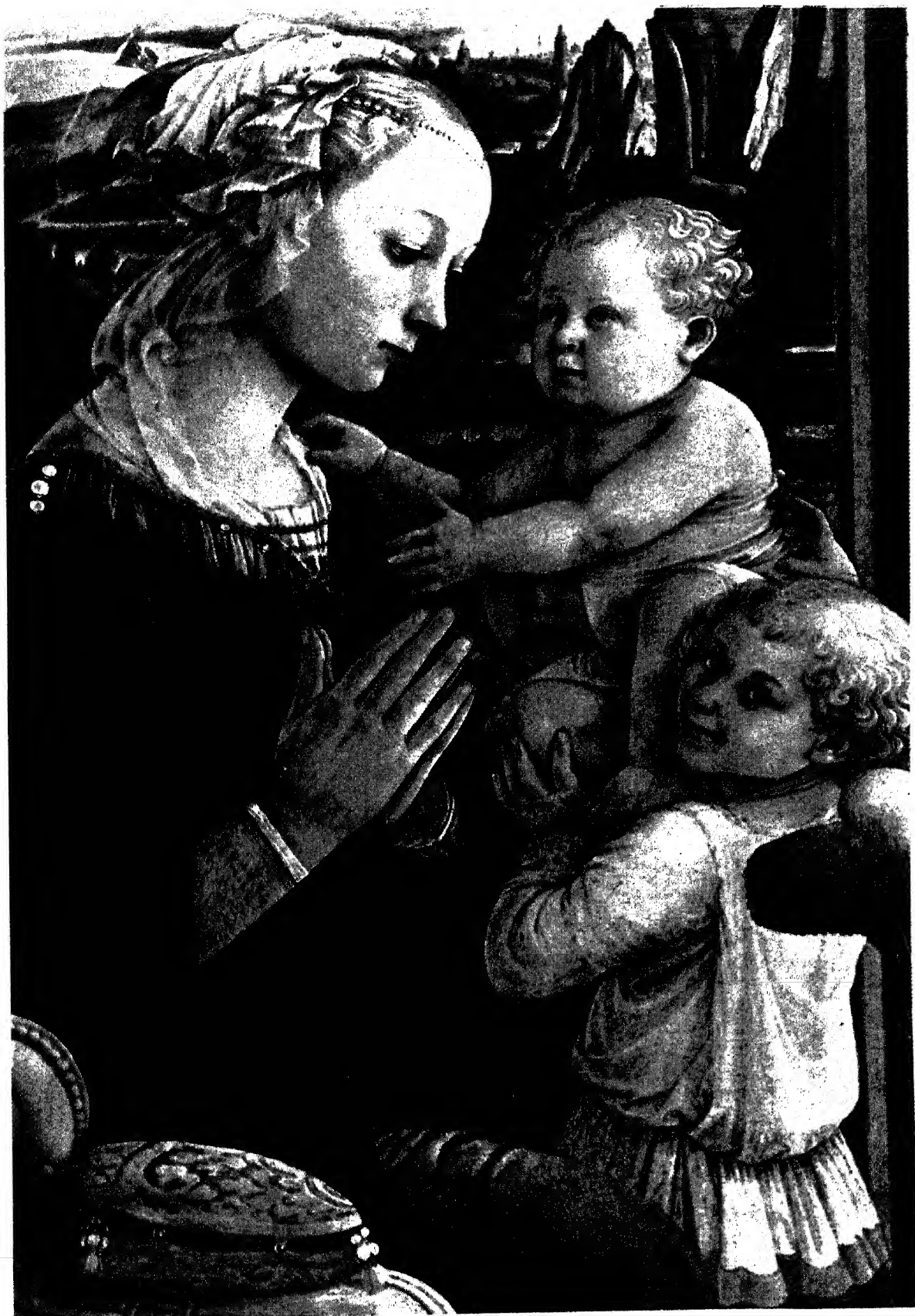
Florentine Painting. Together with the Sienese school (q.v.), the Florentine school dominated Italian painting in the late 13th and the 14th century, and then held sole dominance during the 15th century. Up to the 13th century Florentine art, along with nearly all western European art, had been Byzantine or Gothic in character. From the late 13th century through the end of the 15th century Florentine painting departed more and more from the flat, static, formalistic, and stylized aspects of Gothic art and Byzantine art (qq.v.). That development was part of the general upheaval of attitudes and values occasioned by the Renaissance. The new scientific spirit of the Renaissance and the new value which it placed on the individual found expression in the graphic arts. There emerged a desire to represent man and his surrounding world with the utmost precision and fidelity; see HUMANISM. Thus, Florentine painting over these centuries represents a steady evolution toward increasingly naturalistic pictorial representation.

The first painter who perceptibly departed from Byzantine art was Giovanni Cimabue. Though his work retains Byzantine features, it begins to foreshadow a new era of realistic, spatial, and anatomical representation and genuine emotional expression in art. Cimabue's pupil Giotto, who carried these tendencies still further, is regarded as the true precursor of Florentine Renaissance painting. His frescoes on religious subjects display revolutionary advances manifest in the attempt to convey depth, in the

depiction of landscape and architecture instead of the solid-gold background, and above all in the treatment of human figures. Unlike previous painters, Giotto differentiated among individual figures. He made each a distinct entity expressive of readily recognizable emotions. A number of Florentine painters, including Taddeo Gaddi, Bernardo Daddi (fl. about 1320–50), and Giotto (fl. 1350–75), continued to produce Giottoesque works throughout the remainder of the 14th century. The next major advance in Florentine painting appeared in the second part of the 14th century in the work of Orcagna. Although he clung to the flat, two-dimensional representation typical of Gothic and Byzantine art, his vigorous and individualized modeling of his figures foreshadowed the Renaissance concern with correct anatomical and psychologically revealing portrayal.

The Renaissance in Florentine painting properly may be said to begin in the first half of the 15th century with the work of Masaccio, the most important painter of the early Renaissance. His work is characterized by monumental subject matter and by careful attention to anatomical representation. Even more important, his revolutionary use of light and shadow paved the way for the perfection of spatial and aerial perspective achieved by later artists. Masaccio's influence was extremely strong among an important group of mid-15th century Florentine painters who are known as the scientific painters because of their direct application of scientific discoveries to painting. This group included Paolo Uccello, the great early master of linear perspective; Andrea del Castagno, the first painter who dissected corpses to obtain knowledge of anatomy; Antonio Pollaiuolo (1429–98), who produced masterful portrayals of the human body in motion; and Andrea del Verrocchio, a pioneer in atmospheric perspective. Contemporary with this group were the so-called spiritual painters who, though indebted to the Renaissance for their techniques, clung to the Gothic school in ideals and aims. They still sought to spiritualize rather than humanize their religious scenes. Among this group were Fra Angelico, who painted devout and tender works, and Fra Filippo Lippi and Benozzo Gozzoli, both of whom incorporated many scientific elements into works of a lyrical nature.

Toward the end of the century there appeared another important group of painters, who combined and elaborated features of both the scientific and spiritual groups. Among them were Domenico Ghirlandaio, Piero di Cosimo, and Sandro Botticelli. Botticelli, one of the



Florentine Painting, Plate 1. "Madonna and Child with Angels" by the Florentine artist Fra Filippo Lippi.



Florentine Painting. Plate 2. Detail of "Rout of San Romano", one of three panels by Paolo Uccello celebrating a victory of the Florentines over the Sienese in 1432.

greatest Florentine masters, produced works, both religious and mythological, which have a remarkable delicacy and translucency. His human figures are depicted so as to radiate an ethereal quality despite their extremely sharp delineation.

Florentine art reached its greatest heights in the works of two late-15th century, or High Renaissance, artists, Leonardo da Vinci and Michelangelo. Both represented the ultimate, perfect fusion of the currents of Renaissance art and thought. They carried to the utmost limits the achievements of their predecessors in linear and aerial perspective and in naturalistic anatomical representation. In addition, they achieved in their painting a transcendent psychological expression, which took the form in Da Vinci's work of all-pervasive, enigmatic quietude, and in Michelangelo's work, of a scarcely contained dynamism and inner turmoil. Their most important contemporaries, Andrea del Sarto and Fra Bartolommeo, also were fine painters. Both Del Sarto and Fra Bartolommeo achieved special brilliance as colorists.

After the first quarter of the 16th century, the Florentine school lost its ascendancy in Italian painting to the Venetian school.

Florentine Sculpture. The sculpture of Florence during the Renaissance was subject to the same social and cultural influences as Florentine painting. The 14th-century Pisan sculpture rivaled the sculpture of Florence, and Andrea Pisano, the man generally considered the founder of Florentine sculpture, was probably born in Pisa. His work was done mainly in relief. The outstanding Florentine sculptor of the 15th century was Donatello who, breaking with medieval tradition, united careful observation of the mechanics of the human body with his sense for classic form.

Among other famous Florentine sculptors are Lorenzo Ghiberti, whose sculptured doors for the baptistery of San Giovanni in Florence were acclaimed by Michelangelo as the Gate to Paradise; Michelozzo, who was associated with both Donatello and Ghiberti and is famous for his figures; and Luca della Robbia, originator of and best known for glazed terra-cotta sculpture in relief and in the round.

A number of Florentine painters were famous as sculptors as well, among them Antonio Pollaiuolo, Andrea del Verrocchio, and Michelangelo, who regarded himself primarily as a sculptor.

In many cases the sculptors of Florence were also architects. Among them were Andrea Sansovino and his pupil Jacopo Sansovino; see SAN-SOVINO, ANDREA. A number of sculptors were also



"Saint George", a statue by Donatello.

Alinari

workers in precious and other metals. The best known of the goldsmith-sculptors is Benvenuto Cellini.

See separate articles on individuals whose birth and death dates are not given. H.B.

FLORES, island of Indonesia, one of the Lesser Sundas, between the Flores and Sawu seas, w. of Timor. Flores is 224 mi. long from e. to w. and about 35 mi. wide. The terrain is extremely mountainous, with peaks rising more than 7000 ft. and a number of active volcanoes. The inland portions of the island are heavily forested. The few rivers by which the island is traversed are not navigable. The population is chiefly Malayan-Papuan. The principal agricultural products cultivated are corn, rice, coconuts, cinnamon, coffee, tobacco, cotton, and wax. Livestock and poultry are raised, and there is some exploitation of mineral deposits. Large quantities of mother-of-pearl are obtained from the fisheries of the Flores Sea. Area, 5480 sq.mi. pop. (latest est.) 900,000.

FLORES, Juan José (1800–64), Ecuadorian soldier and statesman, first president of Ecuador, born in Puerto Cabello, Nueva Granada (now Venezuela). At the age of fifteen he began fighting in the Wars of Independence, becoming a lieutenant to the revolutionary leader Simón Bolívar (q.v.); see SOUTH AMERICA: *History*. When Ecuador became an independent state in 1830, Flores became the first president, serving for

FLOREY

five years (see ECUADOR: *History*). During the next four years the presidency was held by the Ecuadorian statesman Vicente Rocafuerte (1783–1847), but Flores regained it in 1839 and served until 1845 when he was deposed. He then went into exile. In 1860 he returned to help the Ecuadorian statesman Gabriel García Moreno (q.v.) reestablish a central government that had been allowed to become enfeebled and powerless. Flores became vice-president and commander of the army. He died while putting down a rebellion. Flores was autocratic and capricious and his conduct of the presidency was characterized by despotic behavior and the ruthless suppression of revolts.

FLOREY, Sir Howard Walter (1898–1968), British pathologist, born in Adelaide, Australia, and educated in medicine at the University of Adelaide. He later studied and taught in England and in 1935 was appointed director of the Dunn School of Pathology, University of Oxford. He investigated the bacteriolytic properties of lysozyme, which Sir Alexander Fleming (q.v.) had discovered in mucous membranes in 1922. After extracting and purifying this substance, Florey studied other naturally occurring antibacterials, of which penicillin (q.v.), also discovered by Fleming in 1928, was the most promising. In 1939 Florey and the German-British biochemist Ernst Boris Chain (q.v.) isolated penicillin from its weak culture medium, concentrated it, demonstrated its antibacterial potency and nontoxic qualities in mice and human subjects with the minute quantities then available, and formulated procedures for extraction and production. The inability of British pharmaceutical houses to initiate large-scale production forced Florey in 1941 to take his process to the United States, where private and government laboratories produced sufficient quantities for broad-scale tests, which Florey conducted on wounded soldiers in North Africa in 1943. For his work he was knighted in 1944, shared the Nobel Prize in medicine in 1945 with Chain and Fleming, was elected president of the Royal Society in 1960, and was created a life peer in 1965. See ANTIBIOTIC.

FLORIANÓPOLIS, formerly DÊSTERRO, city and seaport in Brazil, and capital of Santa Catarina State, on Ilha de Santa Catarina, about 300 miles s. of São Paulo. A suspension bridge connects the island with the mainland. Situated within a rich agricultural region, Florianópolis is a commercial and cultural center. In the city are faculties of the University of Santa Catarina. Founded about 1700, the city received its present name in 1893. Pop. (1970 prelim.) 115,665.

FLORICULTURE, cultivation of ornamental flowering plants for aesthetic purposes, whether grown in window boxes, greenhouses, or gardens. In floriculture, plants are grown for individual effect; in landscape gardening, for total effect; see GARDENING; HORTICULTURE; LANDSCAPE ARCHITECTURE. Although flowers have been cultivated in civilized countries back to early Egyptian, Greek, and Roman times, commercial cultivation has been practiced for only about 100 years. Climatic conditions, especially in the northern United States, make it necessary to raise many flowers and plants native to other countries in greenhouses to meet their requirements for heat and light; see PHOTOPERIODISM. Economic considerations dictate the same practice. See also separate articles on many flowers.

FLORIDA, southernmost of the South Atlantic States of the United States, bounded on the n. by Alabama and Georgia, on the e. by the Atlantic Ocean, on the s. by Florida Strait (separating Florida and Cuba), and on the w. by Alabama and the Gulf of Mexico.

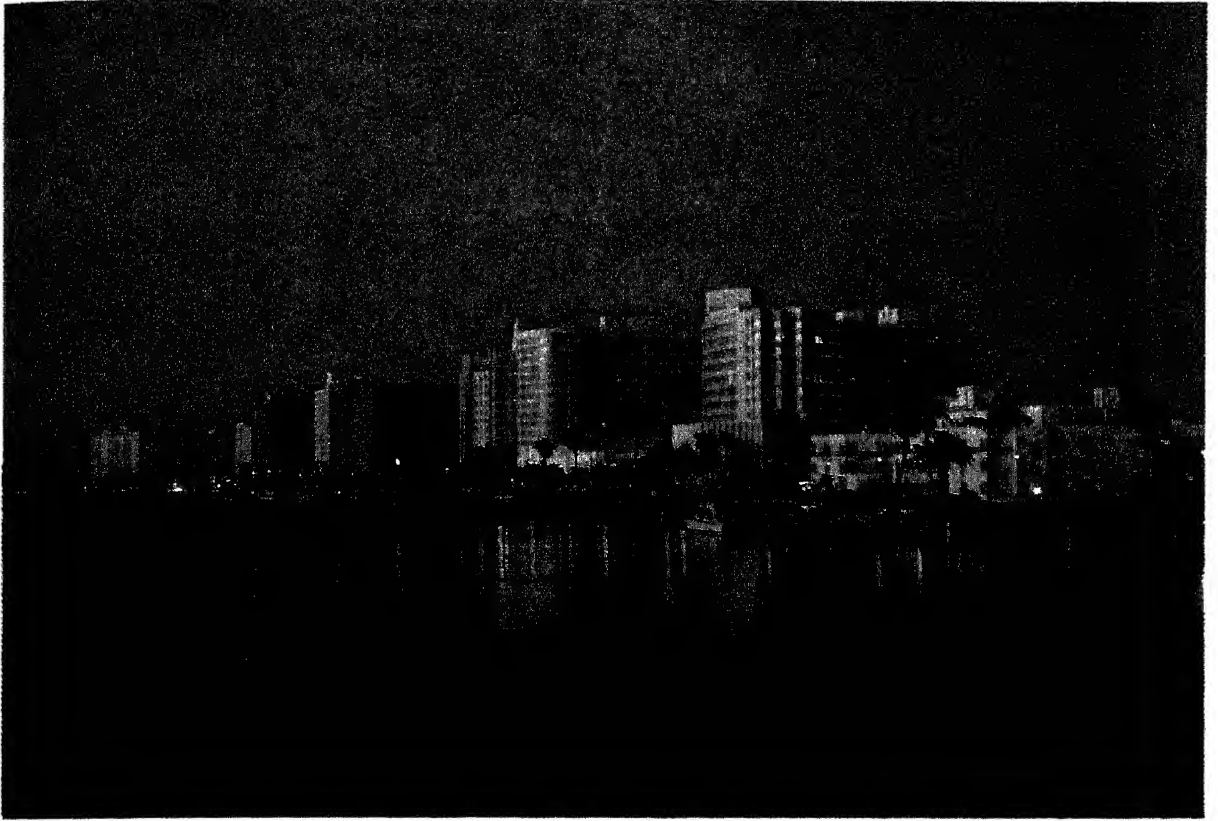
Except for the region contiguous to Alabama and Georgia, Florida consists of a peninsula of the North American continent, projecting southward between the Atlantic Ocean and the Gulf of Mexico for a distance of about 375 mi. The portion of the State above the peninsula has an extreme width from e. to w. of about 361 mi.; the width of the peninsula averages about 150 mi. In a n. and s. direction, the State has an extreme length of 447 mi.

Area (22nd State in rank)	58,560 sq. mi.
Land	54,090 sq. mi.
Inland water	4470 sq. mi.
Population	(1970, 9th in rank) 6,789,443
	(1960, 10th in rank) 4,951,560
	(1950) 2,771,305
Altitude	sea level to 345 ft.
Capital	Tallahassee (1970) 71,897
Largest city	Jacksonville (1970) 528,865
Entered Union (27th State)	March 3, 1845
Nickname	The Sunshine State
Motto	In God We Trust
Song	"Swanee River"
Tree	Sabal palm
Flower	orange blossom
Bird	mockingbird

THE LAND

The coastline of Florida, longest of any State of the Union, totals about 1197 mi. Including the coastlines (about 679 mi.) of off-lying islands, mainly the Florida Keys (q.v.), and measured around bays, inlets, and tidal estuaries, the Florida waterline has a length of about 8426 mi.

Although the mean elevation of Florida is only 100 ft., the lowest of any State in the Union except Delaware and Louisiana, the topography of the State is widely diversified. The e. portion of the mainland area is an extension of the At-



Florida. Plate 1. Above: View of the oceanfront lined with luxury hotels at Miami Beach. Below: The magnificent palms that flank McGregor Boulevard in Fort Myers were planted by the American inventor Thomas A. Edison, who made his winter home in the city.

Florida State News Bureau





Florida. Plate 2. *Scenes in Everglades National Park. Above: A swamp of bald cypresses, deciduous pine trees whose roots form natural crooks that extend above the water. Below: American egrets in a bird sanctuary. The egret was almost exterminated by hunters for its plumes before the passage of protective legislation.*

National Park Service



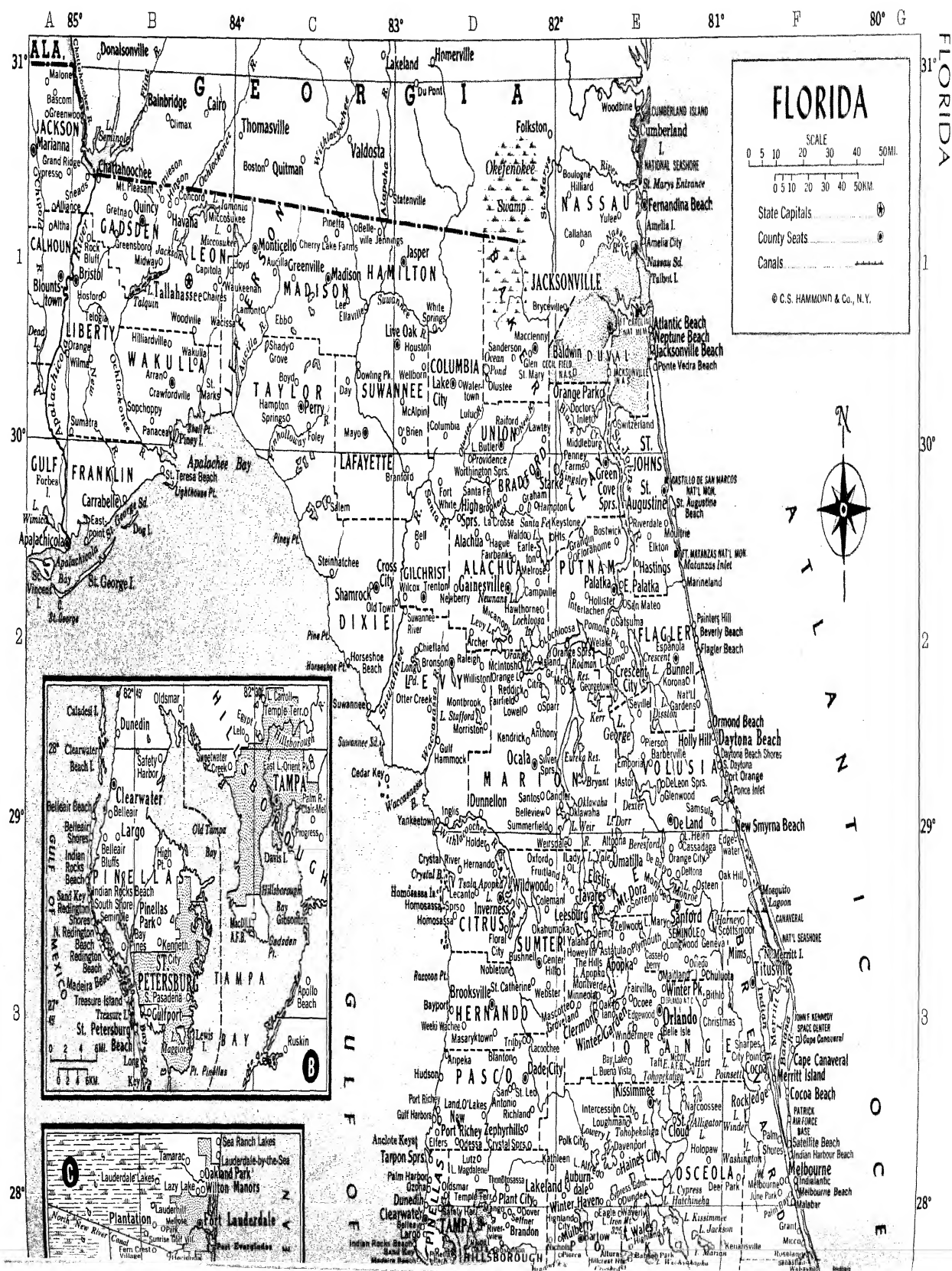
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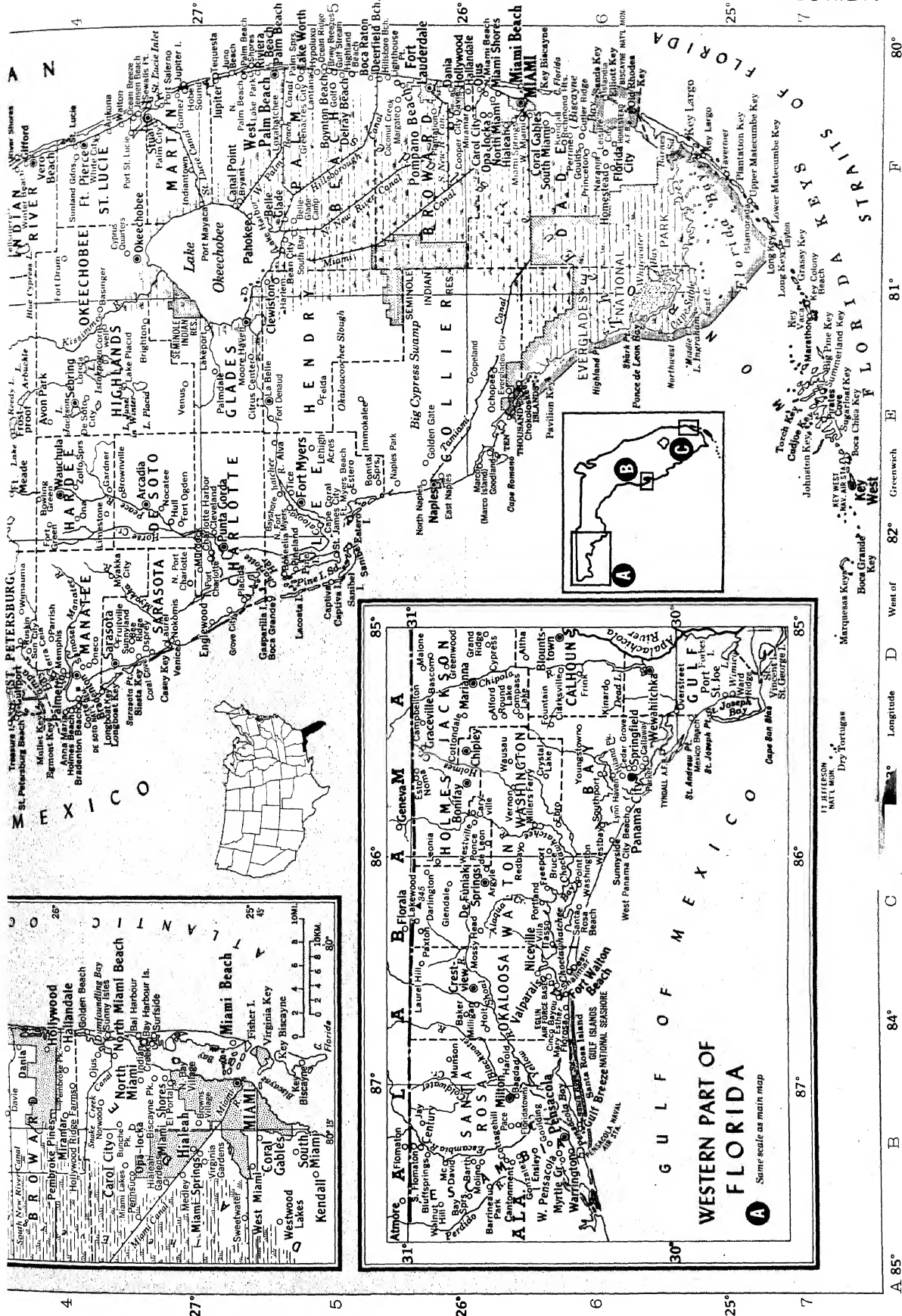
Cities and Towns

Alachua.....	D 2	Cortez.....	D 4	Green Cove Springs ○	E 2	Laurel Hill.....	C 5
Alford.....	D 6	Cottagehill.....	B 6	Greensboro.....	B 1	Lawtey.....	D 1
Altha.....	A 1	Cottondale.....	D 5	Greenville.....	C 1	Lee.....	C 1
Altosna.....	E 3	Crawfordville ○	B 1	Greenwood.....	A 1	Leesburg.....	E 3
Alturas.....	E 4	Crescent City.....	E 2	Gretna.....	B 1	Lehigh Acres.....	E 5
Anna Maria.....	D 4	Crestview.....	C 6	Groveland.....	E 3	Leisure City.....	F 6
Apalachicola ○	A 2	Cross City ○	C 2	Gulf Breeze.....	B 6	Lighthouse Point.....	F 5
Apopka.....	E 3	Crystal Lake.....	D 6	Gulf Hammock.....	D 2	Live Oak ○	D 1
Arcadia ○	E 4	Crystal River.....	D 3	Gulfport.....	B 3	Lloyd.....	C 1
Archer.....	D 2	Crystal Springs.....	D 3	Hacienda.....	B 4	Longboat Key.....	D 4
Astatula.....	E 3	Cutler Ridge.....	F 6	Haines City.....	E 3	Longwood.....	E 3
Atlantic Beach.....	E 1	Cypress.....	A 1	Hallandale.....	B 4	Lorida.....	E 4
Auburndale.....	E 3	Dade City ○	D 3	Hampton.....	D 2	Loughman.....	E 3
Aucilla.....	C 1	Dania.....	B 4	Harlem.....	F 5	Loxahatchee.....	F 5
Avon Park.....	E 4	Davenport.....	E 3	Harold.....	B 6	Lutz.....	D 3
Babson Park.....	E 4	Davie.....	B 4	Hastings.....	E 2	Lynn Haven.....	C 6
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Bal Harbour.....	C 4	De Bary.....	E 3	Hialeah.....	B 4	Maitland.....	E 3
Barberville.....	E 2	Deerfield Beach.....	F 5	Highland City.....	E 4	Malabar.....	F 3
Bartow ○	E 4	De Funiak Springs ○	C 6	High Point.....	B 3	Malone.....	A 1
Bay Harbor Isles.....	B 4	De Land ○	E 2	High Springs.....	D 2	Mango.....	D 4
Bee Ridge.....	D 4	DeLeon Springs.....	E 2	Hilliard.....	E 1	Marathon.....	E 7
Belleair.....	B 2	Delray Beach.....	F 5	Hinson.....	B 1	Marianna ○	A 1
Belleair Beach.....	B 2	De Soto City.....	E 4	Hobe Sound.....	F 4	Marineland.....	E 2
Belleair Bluffs.....	B 3	Destin.....	C 6	Holly Hill.....	E 2	Mary Esther.....	B 6
Belle Glade.....	F 5	Doctors Inlet.....	E 1	Hollywood.....	B 4	Masaryktown.....	D 3
Belle Isle.....	E 3	Dover.....	D 4	Holmes Beach.....	D 4	Mascotte.....	E 3
Bellevue.....	D 2	Dundee.....	E 3	Holt.....	C 6	Mayo ○	C 1
Belleview.....	C 1	Dunedin.....	B 2	Homestead.....	F 6	McAlpin.....	D 1
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Blountstown ○	A 1	Eagle Lake.....	E 4	Homosassa Sprs.....	D 3	Melbourne.....	F 3
Boca Raton.....	F 5	East Palatka.....	E 2	Horseshoe Beach.....	C 2	Melbourne Beach.....	F 3
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Bonita Springs.....	E 5	Edgewater.....	F 3	Howey in the Hills.....	E 3	Memphis.....	D 4
Bowling Green.....	E 4	Elfers.....	D 3	Immokalee.....	E 5	Merritt Island.....	F 3
Boynton Beach.....	F 5	Elkton.....	E 2	Indianalantic.....	F 3	Miami ○	B 5
Bradenton ○	D 4	El Portal.....	B 4	Indian Harbour Beach.....	F 3	Miami Beach.....	C 5
Bradenton Beach.....	D 4	Englewood.....	D 5	Indian Rocks Beach.....	B 3	Miami Shores.....	B 4
Bradley.....	D 4	Ensley.....	B 6	Indian Rocks Beach.....	B 3	Miami Springs.....	B 5
Brandon.....	D 4	Estero.....	E 5	South Shore.....	B 3	Micanopy.....	D 2
Brandon.....	D 2	Eustis.....	E 3	Indianatown.....	F 4	Mico.....	F 4
Bristol ○	B 1	Everglades City.....	E 6	Inglis.....	D 2	Miccosukee.....	B 1
Bronson ○	D 2	Fairville.....	E 3	Intercession City.....	E 3	Middleburg.....	E 1
Brook.....	D 2	Felda.....	E 5	Interlachen.....	E 2	Milligan.....	C 6
Brooksville ○	D 3	Fellsmere.....	F 4	Inverness ○	D 3	Milton ○	B 6
Bryant.....	F 5	Fernandina Beach ○	E 1	Islamorada.....	F 7	Mims.....	F 3
Bunnell ○	E 2	Flagler Beach.....	E 2	Jacksonville ○	E 1	Minneola.....	E 3
Bushnell ○	D 3	Floral City.....	D 3	Jacksonville Beach.....	E 1	Miramar.....	B 4
Callahan.....	E 1	Florida City.....	F 6	Jasper ○	D 1	Molino.....	B 6
Campbellton.....	D 5	Floridatown.....	B 6	Jay.....	B 5	Montbrook.....	D 2
Canal Point.....	F 5	Florosa.....	B 6	Jennings.....	C 1	Monticello ○	C 1
Cantonment.....	B 6	Foley.....	C 1	Jensen Beach.....	F 4	Montverde.....	E 3
Cape Canaveral.....	F 3	Fort Drum.....	F 4	Juno Beach.....	F 5	Moore Haven ○	E 5
Cape Coral.....	E 5	Fort Green.....	E 4	Jupiter.....	F 5	Mount Dora.....	E 3
Capitola.....	B 1	Fort Lauderdale ○	C 4	Kathleen.....	D 3	Mulberry.....	E 4
Carol City.....	B 4	Fort McCoy.....	E 2	Kendall.....	B 5	Myrtle Grove.....	B 6
Carrabelle.....	B 2	Fort Meade.....	E 4	Kendrick.....	D 2	Naples ○	E 5
Caryville.....	C 6	Fort Myers ○	E 5	Kenneth City.....	B 3	Naranja.....	F 6
Cassadaga.....	E 3	Fort Myers Beach.....	E 5	Key Largo.....	F 6	Neptune Beach.....	E 1
Cedar Grove.....	D 6	Fort Ogden.....	E 4	Keystone Heights.....	E 2	Newberry.....	D 2
Cedar Key.....	C 2	Fort Pierce ○	F 4	Key West ○	E 7	New Port Richey.....	D 3
Center Hill.....	D 3	Fort Walton Beach.....	C 6	Kinard.....	D 6	New Smyrna Beach.....	F 2
Century.....	B 5	Fort White.....	D 2	Kissimmee ○	E 3	Niceville.....	C 6
Charlotte Harbor.....	E 5	Freeport.....	C 6	La Belle ○	F 5	Nichols.....	E 4
Chattahoochee.....	B 1	Frink.....	D 6	Lacoochee.....	D 3	Nocatee.....	E 4
Cherry Lake Farms.....	C 1	Frostproof.....	E 4	Lady Lake.....	E 3	Nokomis.....	D 4
Chiefland.....	D 2	Fruitland Park.....	D 3	Lake Alfred.....	E 3	North Bay Village.....	B 5
Chipley ○	D 6	Fruitville.....	D 4	Lake Butler ○	D 1	North Miami.....	B 4
Christmas.....	E 3	Gainesville ○	D 2	Lake City ○	D 1	North Miami Beach.....	C 4
Cinco Bayou.....	B 6	Geneva.....	E 3	Lake Harbor.....	F 5	North Palm Beach.....	F 5
Citra.....	D 2	Georgetown.....	E 2	Lake Helen.....	E 3	North Redington Beach.....	B 3
Citrus Center.....	E 5	Gibsonton.....	C 3	Lake Jem.....	E 3	Oak Hill.....	F 3
City Point.....	F 3	Gifford.....	F 4	Lakeland.....	D 3	Oakland.....	E 3
Clarksville.....	D 6	Glendale.....	C 5	Lake Mary.....	E 3	Oakland Park.....	B 3
Clearwater ○	B 2	Glen Saint Mary.....	D 1	Lake Monroe.....	E 3	Ocala ○	D 2
Clermont.....	E 3	Golden Beach.....	C 4	Lake Park.....	F 5	Ocean Ridge.....	F 5
Clewiston.....	E 5	Golden Gate.....	E 5	Lake Placid.....	E 4	Ocoee.....	E 3
Cocoa.....	F 3	Gonzalez.....	B 6	Lake Wales.....	E 4	Ojus.....	B 4
Cocoa Beach.....	F 3	Goodland.....	E 6	Lake Worth.....	G 5	Okahumpka.....	D 3
Coleman.....	D 3	Goulding.....	B 6	Lamont.....	C 1	Okeechobee ○	F 4
Concord.....	B 1	Goulds.....	F 6	Land O'Lakes.....	D 3	Oklawaha.....	E 2
Cooper City.....	F 5	Graceville.....	D 5	Lantana.....	F 5	Oldsmar.....	B 2
Coral Gables.....	B 5	Grand Ridge.....	A 1	Largo.....	B 3	Olustee.....	D 1
		Grant.....	F 4	Lauderdale-by-the-Sea.....	C 3	Oneco.....	D 4
		Greenacres City.....	F 5	Lauderdale Lakes.....	B 4	Opa-locka.....	B 4
				Laurel.....	D 4		

○ County seat.

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WESTERN PART OF FLORIDA

Same scale as main map



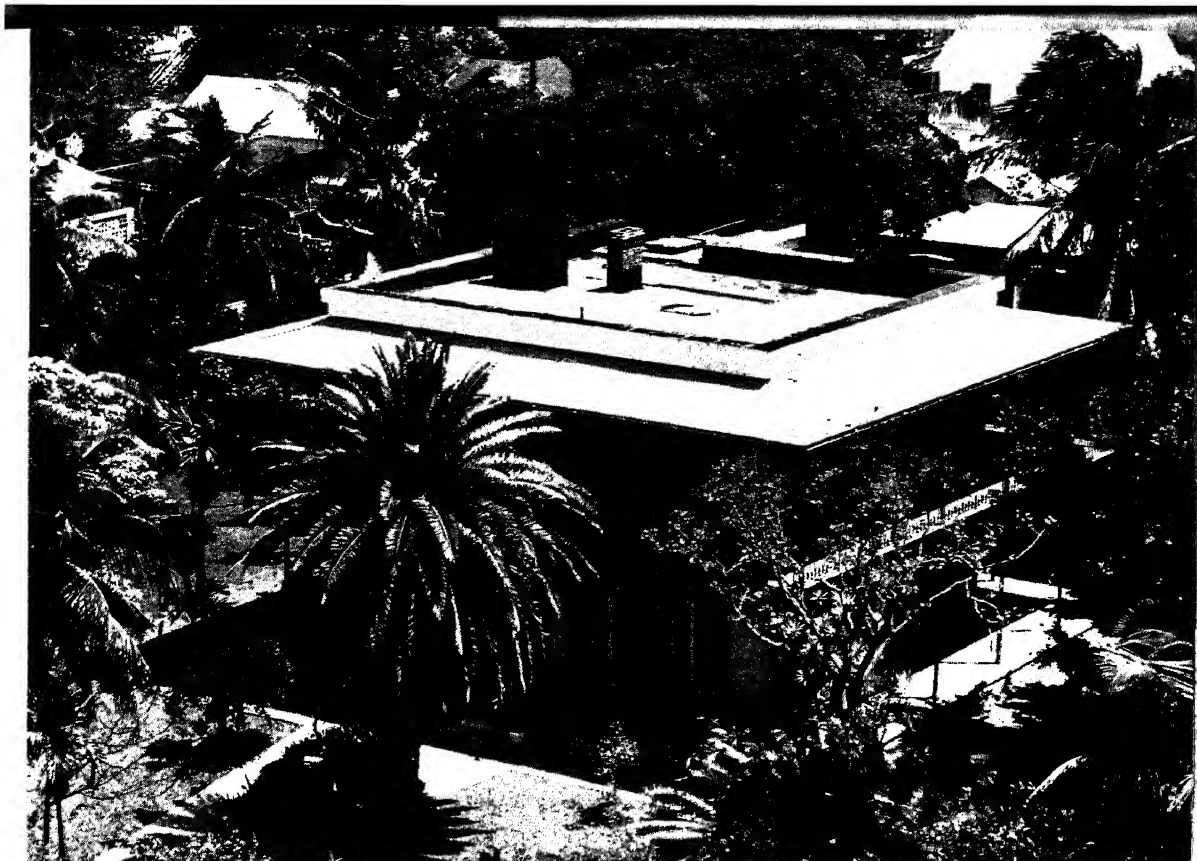
A 85° B 84° C 83° D 82° E 81° F 80°

27° 26° 25°

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Home of Nobel Prize winning author Ernest Hemingway in Key West, where he wrote many of his famous works.

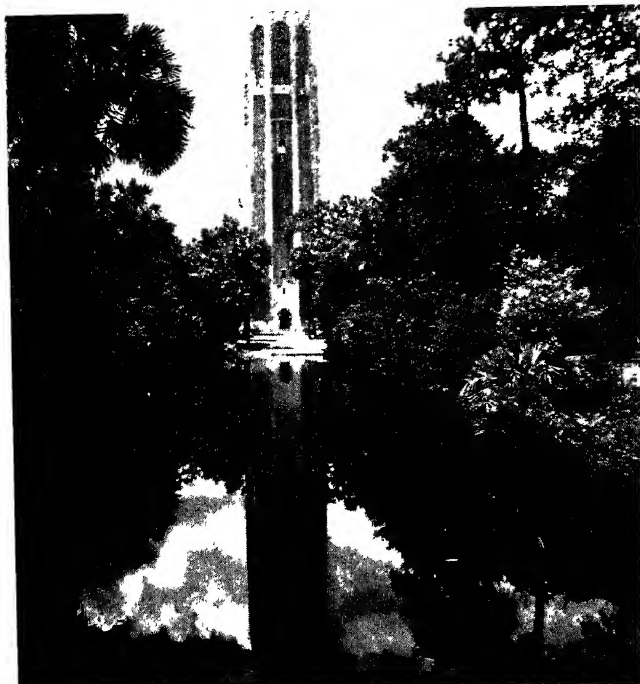
Florida News Bureau

lantic coastal plain, and the mainland area to the w. consists largely of rolling hills, related geologically to the Alabama highlands. The peninsula is bisected by a longitudinal ridge, extending s. about 200 mi. This ridge, consisting mainly of limestone, contains along its upper reaches extensive coniferous forests. Numerous bays and inlets indent the Gulf coast of Florida, providing excellent harbors such as those of Tampa, Saint Petersburg, and Pensacola. The outstanding feature of the Atlantic coastline is the nearly unbroken fringe of low islands, islets, and promontories extending generally parallel to the peninsula and enclosing a 100-mi. sound called the Indian R., which is part of the Atlantic Intracoastal Waterway. The commercially important ports on the Atlantic are Jacksonville, Miami, Fort Pierce, West Palm Beach, Key West (qq.v.), Fernandina, Port Everglades, and Port Canaveral.

Rivers and Lakes. The Saint Johns R., the principal river of Florida, rises in the east-central part and flows n. into the Atlantic Ocean near Jacksonville. The Caloosahatchee R., an outlet of Lake Okeechobee in the s., flows westward into the Gulf of Mexico. The Kissimmee R., 94 mi. long in the center of the peninsula, flows from Lake Tohopekaliga through Lake Kissimmee and southward into Lake Okeechobee. In the mainland portion of the State rivers include the Suwannee and Apalachicola (qq.v.); the Perdido,

which forms the boundary with s.w. Alabama; and the Saint Marys, which forms part of the boundary with Georgia in the n.e.

The peninsular terrain is broken by a multitude of lakes and swamps. The number of named lakes, many of which are connected by sluggish streams, is more than 11,000, a total greater than that of any other State. Lake Okeechobee (q.v.), in the s., is the largest lake in Florida and the second-largest freshwater lake within the boundaries of a single State. Other lakes include Lake Worth (an 18-mi. lagoon on the e. coast); the previously mentioned lakes Tohopekaliga and Kissimmee; and Lake George in the n.e. Among the swamps are Okefenokee Swamp, in the n.e., and Big Cypress Swamp, in the s.w. Big Cypress, like many of the peninsular swamps, contains extensive stands of aquatic trees, as well as some of the few remaining stands of cypress trees. The Everglades (q.v.), a vast marshland interspersed with thousands of islets, occupies 1,400,533 acres of the peninsula s. of Lake Okeechobee and e. of Big Cypress Swamp. Another noteworthy feature of the peninsula is the large number of freshwater and mineral springs, seventeen of which are of first magnitude, more than any other State. Among



The Singing Tower near Lake Wales in central Florida rises 234 ft. from the crest of Iron Mountain. It is part of a 58-acre park and bird sanctuary established by the American journalist Edward William Bok. The richly decorated carillon tower was dedicated in 1929 as a memorial to Bok, who is buried in a crypt at its base.

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the most notable are Silver Springs and Rainbow Springs, in Marion County, and Homosassa Springs, in Citrus County. Much of the drainage of the peninsula flows through subterranean streams, which, like the springs and natural caves, result from the calciferous nature of the geological strata.

Climate. The climate is probably the greatest natural resource of Florida. Conditions range from a transition zone between temperate and subtropical in the n. interior to tropical in the s. and the Keys. Summers are long, warm, and relatively humid throughout the State; winters are mild in the n. and moderate in the s. Because of the Gulf Stream, coastal areas are warmer in winter and cooler in summer than inland points at the same latitude. The highest temperature recorded in the State was 109° F. (at Monticello); the lowest, -2° F. (at Tallahassee). Summers are tempered by sea breezes along the coast and by frequent thundershowers. An occasional cold wave brings temperatures of 15° to 20° F. in the n. and freezing or below in the s., except Key West. Rainfall is abundant; snow is rare. In general the rainy season is from June through September. On average, the sun shines in Florida more than two thirds of the time sunlight is possible during the year. The average annual number of days with measurable precipitation ranges from 115 at Jacksonville to 113 at Key

West, 125 at Miami Beach, and 112 at Pensacola. Tornadoes average 10 to 15 per year. Tropical storms average 1.7 per year, but in individual years vary from none to five.

Climate	Jacksonville	Key West	Miami Beach
Normal temperatures (in ° F.)			
January maximum	64.6	75.6	75.6
January minimum	44.5	65.8	58.7
July maximum	90.0	89.2	89.1
July minimum	72.0	80.0	75.5
Annual	68.4	78.2	75.5
Normal precipitation (in inches)			
Wettest month	7.89	7.34	9.00
Driest month	1.79	1.52	1.64
Annual	54.47	39.99	59.80
Latest frost	Feb. 6	*	*
Earliest frost	Dec. 16	*	*
Mean number of days between latest and earliest frosts	313	*	*

* When the frequency of occurrence in either spring or fall is one year in ten, or less, mean dates are not given.

Plants and Animals. More than 3000 species of flowering plants grow in Florida; most common among them are blue lupines, mimosa, lantana, white calla, blue iris, clematis, sunflowers, and orchids. The morning glory, yellow jasmine, Cherokee rose, and trumpet vine are also common. A great variety of plants have been introduced, such as the poinsettia, hibiscus, oleander, gardenia, camellia, azalea, golden bignonia (flame vine), and bougainvillea. One of the most beautiful flowering trees is the royal poinciana. It is estimated that nearly half of all the species of trees grown in the U.S. and Canada can be found in Florida. Trees common to n. climates include the sweet gum, yellow poplar, and red maple. Also present are the longleaf pine, magnolia, oak, and cypress. In s. Florida are found royal and coconut palms as well as mahogany and mangroves. The trees most important to Florida are the pine and orange, which have economic significance as well as beauty.

Many of the native mammals of Florida are disappearing as the human population increases. Such animals are the black bear, white-tailed and Key deer, wildcat, gray fox, and Florida panther. Small animals such as rabbits, opossums, squirrels, and raccoons are numerous. Except in swamps, the manatee, or sea cow, is rare. Because of protective legislation, the alligator is fairly common. Turtles, frogs, lizards, spiders, and scorpions are numerous. Local pests are the sand fly, mosquito, and red bug.

Florida is said to have about 700 species of fish in its rivers, lakes, and coastal waters. Most common are mullet, trout, bass, red snapper, pompano, and catfish. The great game fish are sailfish and tarpon. Shrimps, lobsters, oysters, crabs, clams, and conchs are numerous.

In the ponds, lagoons, lakes, and marshes are countless birds, including pelicans, gulls, terns, ducks, herons, water turkeys, ibis, and egrets. Among the common land birds are the mockingbird, woodpeckers, warblers, jays, and cardinals. A number of preserves, sanctuaries, and patrolled tracts for birds and other wildlife are maintained under public and private auspices. Among the notable bird sanctuaries are the Merritt Island National Wildlife Refuge (140,393 acres), the southern migratory point for the white pelican; Saint Mark's National Wildlife Refuge (36,862 acres); and Pelican Island National Wildlife Refuge, for brown pelicans. An ibis rookery is at Orange Lake.

Parks, Forests, and Other Places of Interest.

Everglades National Park (q.v.), in s. Florida, is the largest subtropical wilderness remaining in the U.S. and an important wildlife refuge. Castillo de San Marcos National Monument (q.v.), near Saint Augustine, contains the oldest masonry fort in the country. Fort Jefferson National Monument (q.v.), on the island of Dry Tortugas, is the largest masonry fort in the Western Hemisphere; and Fort Matanzas National Monument (q.v.) is a Spanish fort built in 1737. Biscayne National Monument (q.v.), in the Keys, is an example of a living coral reef. The De Soto National Memorial, near Bradenton, is the probable landing site of the Spanish explorer Hernando De Soto (q.v.) in 1539. Fort Caroline National Memorial (q.v.), on the St. Johns R., is the site of a French settlement of 1564. Gulf Island National Seashore (partly in Mississippi) is near Pensacola. Florida has two national forests comprising more than 1,075,000 acres: Apalachicola, with headquarters in Osceola, and Ocala, with headquarters in the city of Ocala.

Florida maintains seventy-eight State parks. The largest are John Pennekamp State Park (75,130 acres), at Key Largo, an underwater park that is part of the only living coral reef in the Northern Hemisphere; Myakka River State Park (28,875 acres), near Sarasota; Jonathan Dickinson State Park (9563 acres), near Stuart; and Collier Seminole State Park (6423 acres), on U.S. 41. Among notable historic State parks are Fort Clinch (1086 acres) and Fort Pickens (1629 acres). Florida Caverns State Park (1131 acres), near Marianna, contains extensive underground caverns. Maclay Gardens State Park (308 acres) is noted for its flowering shrubs and rare trees. Highlands Hammock State Park (3800 acres), near Sebring, is a subtropical jungle. Torreya State Park (1063 acres), near Bristol, contains rare *Torreya taxifolia* cedars. The State forests include Withlacoochee (113,000 acres), Black-

water River (183,166 acres), Pine Log (7000 acres), and Cary (3500 acres). Florida also has numerous national and State bird sanctuaries and two National Audubon Wildlife sanctuaries.

Florida is the site of the John F. Kennedy Space Center, the U.S. space-vehicle launching site; six United States Air Force bases; and six United States Navy installations, including Pensacola Naval Air Station, the oldest naval air station in the U.S., which has the Naval Aviation Museum, tracing the history of flight. Key West is the most southerly city in the country. Saint Augustine is the oldest (1565) European settlement in the U.S. Other points of interest are the reconstructed Monastery of Saint Bernard of Sacramenia, dating from 1141, which was imported stone by stone to Miami from Segovia, Spain; the Asolo Theater in Sarasota, an 18th-century theater moved from Italy; the Stephen Foster Memorial, at White Springs; and the Singing Tower, a carillon erected by the American philanthropist Edward William Bok (q.v.), at Lake Wales.

Sports. With lakes, rivers, and a long coastline, Florida has much to offer the fisherman. Freshwater fish include bass, pickerel, sunfish, catfish, gar, bluegill, and sturgeon. East-coast saltwater fish are bluefish, Spanish mackerel, tarpon, spotted sea trout, sailfish, and marlin. The w. coast offers red drum, spotted sea trout, snook, tarpon, and snapper. Game animals hunted are white-tailed deer, black bear, feral hog, and wild turkey, in management areas; and small game in other parts of the State.

THE PEOPLE

According to the 1970 decennial census, the population of Florida was 6,789,443, an increase of 37.1 percent over the 1960 population. The urban segment comprised 5,468,137 persons, 80.5 percent of the total, compared with 73.9 percent in 1960. The rural segment comprised 1,321,306 persons, 19.5 percent of the total, compared with 26.1 percent in 1960. Ethnically, the 1970 population was distributed as follows: white persons, 5,719,343; nonwhites, 1,070,100, including 1,041,651 Negroes, 6677 Indians, 5092 Filipinos, 4090 Japanese, 3133 Chinese, and others. The percentage of native-born residents was about 92; of foreign-born, about 8. The major countries of origin of the foreign-born were Cuba, Canada, Great Britain, and Germany. The 1970 population density averaged 125.5 per sq.mi., compared with 91.5 in 1960.

The chief cities are Tallahassee, the capital, a distribution center for an agricultural area; and, in order of population, Jacksonville, a transportation and manufacturing center; Miami, a re-

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sort and manufacturing city; Tampa, the largest port in the State, also known for fruit processing and cigar manufacturing; and Saint Petersburg, a well-known Gulf Coast resort.

The Indian population of Florida consists largely of Seminole. Reservations are at Big Cypress, Brighton, and Hollywood.

Education. The public school system of Florida was established in 1849. Education is free and compulsory for all children between the ages of seven and sixteen.

ELEMENTARY AND SECONDARY SCHOOLS. In 1972 public elementary schools numbered 1435 and public secondary schools, about 475. Enrollment in 1972 was about 872,600 in elementary and 735,100 in secondary schools. Teachers in the public school system in 1972 numbered about 31,900 in elementary and 31,600 in secondary schools. In 1970 private institutions included about 300 elementary and 100 secondary schools; enrollment in 1971 was about 79,000 elementary and about 30,000 secondary students. Teachers in private schools numbered 3950 in the late 1960's.

UNIVERSITIES AND COLLEGES. In 1972 Florida had 62 institutions of higher education, 37 of which were public, and 28 public junior colleges. University and college enrollment was about 254,100. Public institutions include the University of Florida, Florida State University (qq.v.), Florida Agricultural and Mechanical University, Florida Atlantic University, Florida Technological University, the University of West Florida, and the University of South Florida. Private institutions in the State include the University of Miami (q.v.), Florida Southern College, Rollins College, Stetson University, Edward Waters College, Eckerd College, and Bethune Cookman College.

Libraries and Museums. In addition to public libraries in the major cities, Florida has a number of special libraries—university, historical, and institutional. Noteworthy among the museums are, in Jacksonville, the Jacksonville Art Museum, the Cummer Gallery of Art, and the Jacksonville Children's Museum; in Miami, the Vizcaya Art Museum; in Orlando, the Loch Haven Art Center; in West Palm Beach, the Norton Gallery and School of Art; in Winter Park, at Rollins College, the Morse Gallery of Art and the Beal Maltbie Shell Museum; at Gainesville, the Florida State Museum; and at Sarasota, the John and Mabel Ringling Museum of Art and the Circus Museum.

THE ECONOMY

Florida has a diversified economy. Per capita personal income was \$6108 in 1976, compared

with \$6441 for the U.S. as a whole. About 3 percent of the State's workers are employed in agriculture, and a significant number are commercial fishermen. Nonagricultural workers are employed, in descending order of numbers, in wholesale and retail trade; service industries; government; manufacturing; finance, real estate, and insurance; transportation and public utilities; and construction. Tourism is a major source of income, although in recent years Miami Beach and hotels and motels generally have seen fewer patrons than in the prosperous 1960's. Florida has become the home of an increasing number of elderly persons; it has the highest percentage of residents aged 65 and over of any of the States.

Manufacturing. According to a recent survey of manufactures, production workers in Florida totaled 220,700. Most of them were employed in food-processing plants and in the manufacture of apparel, electrical equipment, transportation equipment, and fabricated metal products. The important citrus-fruit industry produces many by-products of citrus-processing: stock feed, citrus molasses, oils, wine, and alcohol. About 26 percent of the workers were employed in the Standard Metropolitan Statistical Area (q.v.) of Miami (coextensive with Dade County). Other manufacturing centers were Tampa-St. Petersburg, Orlando, and Jacksonville. The value added by manufacture (see **VALUE**) in the largest industries totaled \$1.56 billion for food and kindred products, \$740,600,000 for electrical equipment, \$639,200,000 for transportation equipment, \$529,400,000 for fabricated metal products, and \$289,000,000 for apparel. Although the chemical industries ranked sixth in employment, they ranked second in value added, at \$959,000,000. The value added by all manufacturing in Florida in the mid-1970's was about \$7.46 billion annually.

Agriculture. Florida ranks thirteenth among the States in cash receipts from agricultural production. In the mid-1970's about 93,000 persons, including operators and workers, were employed annually on the State's 32,500 farms, which covered 14,000,000 acres. The average farm had 431 acres. The principal commodities, in terms of cash value, are oranges, milk, cattle, and sugarcane. In the mid-1970's annual cash receipts from livestock were \$692,680,000; crop marketings produced income of \$1.84 billion. Total cash receipts from farming, including government payments, were \$2.54 billion.

Fishing. In the mid-1970's some 10,747 persons were employed as commercial fishermen in Florida. The State is divided into two fishing



Above: Surfing is a popular sport along both the Atlantic and Gulf coasts of Florida. Below: The lively antics of the porpoises never fail to entertain the crowds at Marineland, just south of Saint Augustine. Boasting a 700,000-gallon tank, the oceanarium is one of the State's many marine attractions.

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zones. The e. coast, part of the South Atlantic fishery region, provides lobsters, shrimp, catfish and bullheads, mackerel, crabs, snappers, scallops, and menhaden. The w. coast, part of the Gulf States fishery region, provides shrimp, crabs, lobsters, snappers, mullet, mackerel, and oysters. In the mid-1970's the catch of the e. coast was 60,822,000 lb., valued at \$19,090,000; the catch of the w. coast was 123,262,000 lb., valued at \$51,921,000. The most valuable processed products of the e. coast were breaded fresh and frozen shrimp, frozen lobsters, and raw lobster tails. The w. coast processed significant amounts of shrimp, crabs, and oysters. The value of processed fishery products was \$40,770,530 on the e. coast and \$94,532,391 on the w. coast.

Mining. Florida ranks ninth among the States in value of mineral production. The principal products mined are phosphate rock, petroleum, stone, and cement. The value of minerals produced annually during the mid-1970's was about \$1.78 billion, representing 2.85 percent of total U.S. production.

Energy. Generating plants in Florida, with a

capacity of 25,300,000 kw, produced 83.5 billion kw hours of electric energy annually in the mid-1970's. About 15 percent of production and 18 percent of capacity were publicly owned.

Tourism. Florida's greatest single source of income is tourism. More than 31,500,000 persons visit Florida annually, spending \$11.5 billion. Among the more popular attractions are Marineland, at St. Augustine; Walt Disney World, near Orlando; Kennedy Space Center, near Cocoa Beach; Silver Springs, Ocala; Cypress Gardens, Winter Haven; Lion Country Safari, West Palm Beach; and the restoration districts of St. Augustine, Pensacola, and Key West.

Forestry. The forest land of Florida is about two thirds softwoods. Primarily under private ownership, the forest land comprises some 16,700,000 acres. It produces a net annual cut of sawtimber of about 1,154,000,000 bd.ft.

Transportation. The first railroads in Florida were the St. Joseph-Lake Wimico Railroad, inaugurated on April 14, 1836, but later abandoned, and the Tallahassee-St. Marks Railroad Company (April 10, 1834), now the Seaboard Coastline Railroad Company. At present Florida has a total of about 4075 mi. of track. Rural and municipal roads totaled 101,500 mi. in the mid-1970's. In addition, there were 22,846 mi. of Fed-

An excavator digs for valuable phosphate ore in Polk County, Florida. Some of the largest phosphate deposits in the U.S. are in central Florida. Florida News Bureau





Citrus trees cover the land for miles in the central ridge district, the heart of the vast citrus industry of Florida.

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erally aided primary, urban, and secondary roads, including 1407 mi. in the Interstate Highway System. During the same period there were 118 public and 237 private airports. Miami has one of the busiest airports in the U.S., and the State is served by 39 international airlines and 9 local or interstate lines. The major seaports, in terms of tonnage handled, are Tampa, Jacksonville, Port Everglades, Miami, Canaveral Harbor, Pensacola, Charlotte Harbor, Panama City, and Palm Beach Harbor. The Intracoastal Waterway almost surrounds Florida, from Jacksonville around the tip of Florida and up the Gulf Coast to the Anclote R., then picking up again at Apalachicola and running westward to Pensacola. Other commercially important rivers are the Apalachicola in the Gulf system and the St. Johns in the Atlantic system. The Okeechobee Waterway flows from Stuart, through Lake Okeechobee, then on to Ft. Myers; it links with the N.-S. Intracoastal Waterway via canals in the Ft. Pierce-Stuart area. The Cross Florida Barge Canal had been scheduled for completion in 1977 at a cost of about \$185,000,000. But the 185-mi. system, to stretch from the Atlantic to the Gulf of Mexico, was canceled in 1971 after it had been shown that the waterway would cause irreparable damage to swamps and wildlife.

Communications. The first newspaper in the State was the *East Florida Gazette*, founded in St. Augustine in 1783. In the mid-1970's Florida had 52 daily and 33 Sunday newspapers. Among the leading newspapers in the State were the *Miami Herald*, the *St. Petersburg Times*, the *Tampa Tribune*, and the *Florida Times-Union*, published in Jacksonville. Of 346 radio stations operating in the same period, one of the earliest was WQAM, which was established in 1921 in

Miami. About 42 television stations were in operation.

GOVERNMENT

Florida is governed under the constitution as revised in 1968. Executive authority is vested in a governor, a lieutenant governor, and a cabinet (consisting of a secretary of state, an attorney general, a comptroller, a treasurer, a commissioner of agriculture, and a commissioner of education), all elected for four-year terms, and other elected and appointed officials. The governor may not serve more than two consecutive terms. Legislative authority is exercised by the Senate, with 40 members elected for four-year terms; and the House of Representatives, with 120 members elected for two-year terms. The legislature meets annually. The judicial system includes a seven-member supreme court, four district courts of appeal, nineteen circuit courts, and various local and special courts.

Florida is represented in the United States Congress by two Senators and fifteen Representatives.

Local Government. Florida has sixty-seven counties, each divided into five districts, except when otherwise provided by county charter; from each district one county commissioner is elected by popular countywide vote. Other officials include county judges, sheriffs, tax assessors, and tax collectors. Cities and towns may incorporate under general law without a special charter, although many have charters specifically endorsed by the legislature.

Voting Qualifications. Suffrage is extended generally to U.S. citizens eighteen years of age

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who have resided one year in the State and six months in the county. Provisions may be made by law for other bona fide residents of the State who are at least eighteen years of age to vote in the election of Presidential electors.

HISTORY

The first European known to have visited the southeast peninsula of North America was the Spanish navigator Juan Ponce de León (q.v.). In March, 1513, Ponce de León, then governor of Puerto Rico, led an expedition westward in search of an island which, according to native lore, was the site of a fountain of youth. He made his landfall on March 27, Easter Sunday (Sp. *Pascua Florida*, "Feast of Flowers"), and debarked somewhere near the mouth of what is now called the St. Johns River on April 2 or 8, claiming the territory for Spain. In honor of the holy day and possibly in recognition of the luxuriant vegetation of the region, he named his discovery *La Florida*. The explorer cruised along both coasts of the peninsula during the next two months but failed to find the fabulous fountain. Determined to colonize the region and investigate it further, Ponce de León returned to Puerto Rico and thence to Spain (1514), in search of royal sanction and support. He obtained the Spanish monarch's approval of the project and in 1521 established a settlement on the west coast of the peninsula. Hostile natives made repeated attacks on the colony, and its leader, suffering from a wound that later proved fatal, withdrew the group to Cuba. During the next forty years, Florida was visited by other Spanish explorers. A royal expedition, led by Panfilo de Narvaez (1480–1528), landed at Tampa Bay in 1528; more than half of the men died and the treasurer of the expedition, Cabeza de Vaca (q.v.), emerged as the new leader. In 1539 the party was followed by another group, led by Hernando De Soto (q.v.). Continuing native hostility, however, discouraged attempts at colonization.

Subsequently France attempted to establish claims in the region. In 1564 a party of French explorers founded a settlement, called Fort Caroline, near the mouth of the St. Johns R. Fearful that they would establish French claims to the region, Philip II (q.v.), King of Spain, dispatched an expedition against the colony in 1565. On Aug. 28 of that year the Spanish force, led by the mariner Pedro Menendez de Avilés (1519–74) entered a harbor that he named San Augustin; it later became known as St. Augustine, the first permanent European settlement in North America. After establishing a colony there, on Sept. 20 he captured Fort Caroline, which was renamed

San Mateo and became a Spanish outpost. Menendez' savage reprisals against the Huguenots were subsequently avenged by the French adventurer Dominique de Courges (1530–93), who in 1568 led an expedition against Fort San Mateo and hanged the entire garrison, except for a few who escaped. The French, however, were unable at that time to gain a lasting foothold in the region.

After the elimination of the French, Spain attempted to expand its settlement in Florida and introduced the mission system, to control and Christianize the Indians. Spain's most serious competition in the region came from English settlements along the Atlantic coast. Although St. Augustine was burned in 1586 by Sir Francis Drake (q.v.) and plundered by the English buccaneer John Davis in 1668, the Spanish retained their foothold in Florida, the natives of which were systematically exterminated. Pensacola, the second Spanish colony in the region, was founded in 1698. During the War of the Spanish Succession (1702–14), British colonists from South Carolina raided and burned St. Augustine, but were unable to expel the Spanish garrison; see SPANISH SUCCESSION, WAR OF THE. The settlement was attacked by the British repeatedly in the course of the next fifty years, and from 1719 to 1723 the French held Pensacola. In 1763, by the terms of the Treaty of Paris, which ended the Seven Years' War, the American phase of which was the French and Indian War (qq.v.), Spain ceded Florida to Great Britain. In exchange, the British evacuated Havana, captured by them during the war. Florida prospered under British rule and, during the American Revolution, remained loyal to Great Britain. When the revolution broke out, Florida, especially the eastern part, experienced a boom based on an influx of loyalists. West Florida subsequently became a battleground for British and Spanish forces.

In 1783 Florida was returned to Spain by Great Britain, in exchange for the Bahama Islands. Spain's second occupation of Florida was a period of constant friction between the American settlers and the Spanish authorities. Spain, weakened by events in Europe, was unable to maintain order. The Spanish government sold west Florida, which included parts of what are now Alabama and Mississippi, to France in 1795. Following the Louisiana Purchase (q.v.), the United States government in 1819 laid claim to the Florida region west of the Perdido R.

A Period of Settlement. During the War of 1812 (q.v.) the Spanish authorities in Florida displayed prejudice against the U.S. British troops occupied Pensacola in 1814, but were expelled

by General Andrew Jackson (q.v.). Following the war, Seminole Indians, refugee Negro slaves, and American squatters overran the Spanish colony, from which they launched systematic raids into Georgia. In 1814 Jackson invaded the colony in retaliation and temporarily occupied Pensacola. In 1819 the Spanish government ceded Florida to the U.S. in exchange for \$4,100,000. The region was established as a U.S. territory in the following year, with Jackson as governor. During the next twenty years, the Seminole kept the territory in a state of turmoil; see SEMINOLE WARS.

The territorial period of Florida (1822–45) marked its first real development. Settlers came in, chiefly from other Southern States; new towns sprang up; and Tallahassee was founded as the capital. The majority of the Indian population was moved to the peninsula. A road was constructed between Pensacola and St. Augustine, and plantations were developed in the areas between. Efforts were also made to acquire canals, banks, and railroads. In 1826 Floridians elected their own legislative council, and in 1838 the council was replaced by a senate and house of representatives. The same year a constitutional convention met at Saint Joseph to frame a constitution preparatory to the achievement of Statehood. After years of delay and bitter controversy, Florida became a State in 1845. From its admission to the Union until the advent of the Civil War, Florida shared the plantation-slave system and the social pattern of other Southern States.

On Jan. 11, 1861, sixteen years after its admission, Florida seceded from the Union and joined the Confederate States of America (q.v.). Union forces occupied several key points, including Jacksonville and St. Augustine, in the course of the Civil War, but were repulsed during an attempted invasion of the interior in 1864. The legislature of the new State government, organized after the Union victory, refused to ratify the Fourteenth Amendment to the Constitution of the United States (q.v.). As a consequence, Florida became a part of the Third Military District under the Congressional Reconstruction Act, and Negroes were registered as voters by Federal authorities. Quasi-military rule of the State ended on July 4, 1868, following adoption of a new constitution and ratification of the Fourteenth Amendment. The national election of 1876 restored control of the State to the Democratic Party.

Developments after the Civil War. Because of the Civil War, the economic development of the State was retarded in the period immedi-

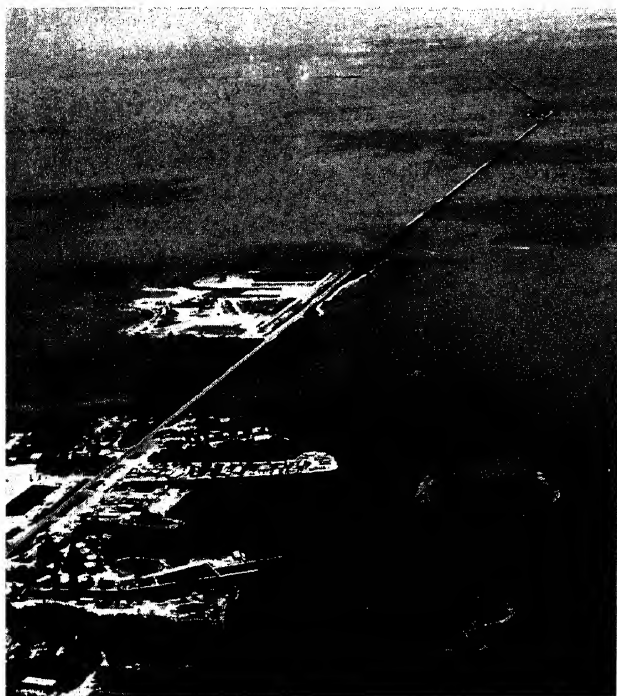
ately thereafter. After 1876 Florida underwent a process of change and development that continued into the 20th century. Notable developments included the extension of transportation, a great influx of population, the rise of new cities, new agricultural, mineral, and industrial production, the big business of tourism, and the improvement of education. Arresting achievements were the drainage of the Everglades, a project initiated in 1905 through the efforts of Governor Napoleon B. Broward (1857–1910), and the refashioning of land situated along the southeast and southwest coasts. The drainage project made possible the development of Florida's rich winter-vegetable region. The refashioning project, of which Miami Beach is the best example, turned barren wastes and mangrove swamps into areas of beauty and usefulness. Economic conditions were further improved by the discovery of rich phosphate deposits, the exploitation of timber resources, the expansion of railway facilities, and the mounting popularity of the State as a winter resort. During the 1920's a nationwide demand for Florida real estate developed, leading to a sharp increase in industrial activity and population. After World War II permanent military bases were located at Jacksonville, Pensacola, Key West, and other points. A missile testing center was established in 1949 at Cape Canaveral from which the first U.S. earth satellite was launched in 1958. In 1963 Cape Canaveral was renamed Cape Kennedy, in honor of President John F. Kennedy (q.v.). The original name was restored in 1973. Its space installation was named the John F. Kennedy Space Center.

In the early 1960's some 300,000 Cuban exiles from the regime of Fidel Castro (q.v.) sought asylum in Florida.

Although tourism remains Florida's largest industry, the State's temperate climate has long attracted many permanent residents. As a result of its rapid growth, Florida began a major expansion of its social services and educational facilities. In 1966 Florida was the only Southern State in which all school districts complied with the requirements of the civil rights acts. But other areas of racial discontent caused flare-ups in several cities.

One of the last States to be developed, Florida has recognized the need to protect its unique wilderness regions from exploitation. By establishing firm guidelines governing land-use management, Florida thus seeks to preserve the State's environment and ecological balance.

FLORIDA KEYS, chain of islands, islets, and reefs, between the Straits of Florida and Florida



A long causeway connects many of the keys of Florida to the mainland.
Florida Department of Commerce

Bay, extending s.w. and w. from Virginia Key, s. of Miami Beach, Fla., to Dry Tortugas (q.v.), a distance of about 225 mi. The keys are chiefly of limestone and coral formation. An overseas highway (1944) extends along the chain from Key Largo, about 40 miles s. of Miami, to the southernmost city in the United States, Key West (q.v.), about 90 miles n. of Havana, Cuba. The larger islands of the group are Key West, Key Largo, Saddlebunch Keys, and Boca Chica. The keys, distributed between Dade and Monroe counties, Fla., for administrative purposes, were devastated in a 1935 hurricane. Several of the islands are popular vacation resorts, and fishing and tourism are the leading industries.

FLORIDA STATE UNIVERSITY, coeducational institution of higher learning, located in Tallahassee, Fla., and founded in 1857. When Florida reorganized its colleges in 1905 (see **FLORIDA, UNIVERSITY OF**), this school, then known as Florida State College, became the foundation for the Florida Female College, and in 1909 its name was changed to Florida State College for Women. It remained a women's college until after World War II, when it became a coeducational university. It is composed of colleges of arts and sciences, education, and law; and schools of business, home economics, library science, music, nursing, criminology, and social work. It offers courses leading to the degrees of

bachelor, master, and doctor. In 1972 the university library housed more than 1,000,000 bound volumes. In 1972 enrollment at the university totaled 19,160 students; the faculty at that time numbered 1272, and the endowment of the university was more than \$86,000.

FLORIDA, STRAITS OF, channel linking the Atlantic Ocean and the Gulf of Mexico, extending between the s. tip of Florida and the island of Cuba (qq.v.). Traversed by the Gulf Stream (q.v.), the strait is about 300 mi. long and from 50 to 150 mi. wide, and has a maximum depth of about 6000 ft.

FLORIDA, UNIVERSITY OF, coeducational institution of higher learning, located in Gainesville, Fla., and founded in 1853. In 1905 the Florida State legislature, in a reorganization of the State educational system, merged six schools of higher learning, including the university, into two institutions, the Florida Female College, in Tallahassee (see **FLORIDA STATE UNIVERSITY**), and the University of the State of Florida, in Gainesville, for men. In 1909 the name of the latter was changed to the University of Florida. After World War II the schools were again reorganized and became coeducational. The University College awards the A.A.S.; the B.A. and B.S. are awarded by the colleges of agriculture, architecture and fine arts, arts and sciences, business administration, education, engineering, health-related professions, journalism and communications, nursing, pharmacy, physical education, and the School of Forest Resources and Conservation. Appropriate degrees are awarded in the colleges of law, dentistry, and medicine, and the graduate school confers degrees in many areas. In 1972 the university libraries housed some 1,550,000 volumes. Student enrollment totaled 23,570; the faculty numbered 3526; and the endowment of the university was about \$9,000,000.

FLORIO, John (1553?-1625), English lexicographer and translator, born in London, the son of an Italian refugee Protestant preacher who fled to London to escape religious persecution. Perhaps educated abroad, he also attended the University of Oxford. He published two series of English-Italian dialogues for teaching, *First Fruites* (1578) and *Second Fruites* (1591), and an Italian-English dictionary, *A Worlde of Wordes* (1598). Among his translations was that of the account of the navigation of the French explorer Jacques Cartier and his version of the *Essays* of the French philosopher, Michel Eyquem de Montaigne (qq.v.), which, because of their vigor, innovation, and philosophical morality, had a profound effect on English literature. Florio was an intimate of many of the leading intel-

lects of his day; despite royal patronage and that of the nobility, he spent much of his life in poverty and died of the plague.

FLORISSANT, suburban residential city of Missouri, in Saint Louis Co., on the Missouri R., about 14 miles N.W. of downtown Saint Louis. Industries include quarrying and the manufacture of iron and steel products. Florissant Valley Community College was founded here in the 1960's. Also situated in the city is Saint Stanislaus Seminary (1831), said to be the oldest Jesuit novitiate in the world. Founded by the French about 1785 as Florissant, the settlement was successively called Saint Ferdinand and Saint Ferdinand de Florissant until the original name was restored in 1939. Pop. (1960) 38,166; (1970) 65,908.

FLORY, Paul John (1910–), American industrial research chemist, educator, and winner of the 1974 Nobel Prize in chemistry. Flory was born in Sterling, Ill., on June 19, 1910. He attended Manchester College and Ohio State University, where he received his doctorate in chemistry in 1934. During the following years he helped develop the ideas and methods that have enabled chemists to create many of the plastics in the world today. He did research on synthetic fibers, synthetic rubber, and other polymers at the Dupont Experimental Station (1934–38), where he was a member of the team that created nylon, and at the Standard Oil Development Company (1940–43) and the Goodyear Tire and Rubber Company (1943–48). Later he served as professor of chemistry at Cornell University (1948–57) and head of research at the Mellon Institute (1956–61); since 1961 he has been professor of chemistry at Stanford University. He was awarded the Nobel Prize for his pioneering research on giant molecules, which make up the common plastics.

FLOSSFLOWER. See *AGERATUM*.

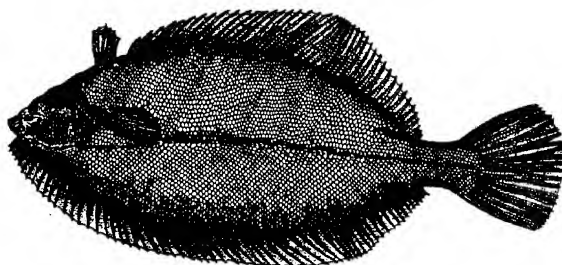
FLOTATION. See *METALLURGY*.

FLOTOW, Baron Friedrich Ferdinand Adolf von (1812–83), German composer, born in Teutendorf. Intended for the diplomatic service, in 1827 he was sent to study in Paris, where he discovered his musical abilities and enrolled for three years at the Conservatoire de Musique. Flotow left Paris in 1830 during the July Revolution (q.v.) but returned in 1835 to write and produce several operas in private theaters maintained by the aristocracy. His first public success was "The Wreck of the Medusa", produced at the Théâtre de la Renaissance in 1839. Between this year and 1878 he produced thirty stage works, of which eighteen were operas and three ballets, in France, Italy, Germany, and Austria.

From 1856 to 1863, he served as director of the court theater at Schwerin, Germany. Only one of Flotow's operas, *Martha*, produced at Vienna in 1847 but originally conceived as a ballet prepared for the Paris Opera in 1844, survives in the repertory.

FLOUNDER, any of several flatfish (q.v.) belonging to the family Bothidae or the family Pleuronectidae and having the body color and both eyes on one side of the body. The body is flat, with scales present in some species and absent in others. These families include such fish as the halibut, dab, and turbot (qq.v.). All flounders are valued as food fish. Several of the common species are called flukes.

In the United States the most important species of flounder is the summer flounder, *Paralichthys dentatus*, also called plaice and deep-sea flounder, which is found in the Atlantic Ocean from Massachusetts to Florida. The adult summer flounder may grow to a length of about 3 ft. and a weight of about 15 lb. It feeds on small marine animals, such as shrimp, crabs, and small fish. Large quantities of these fish are captured between May and October. The winter flounder or lemon sole, *Pseudopleuronectes*



Winter flounder, *Pseudopleuronectes americanus*

americanus, and the four-spotted flounder, *Paralichthys oblongus*, are found along the South Atlantic coast and in the Gulf of Mexico. The diamond flounder, *Hypsopsetta guttulata*, found along the Pacific coast, is another common species. The plaice of Western Europe, *Pleuronectes platessa*, grows to 2 ft. and 10 lb. Two species, *Pleuronectes flesus*, and *Glyptocephalus cynoglossus*, the gray sole or common fluke, are found along the coasts of Great Britain. Several other species are found in arctic waters.

FLOUR, finely ground meal of grains of wheat, obtained by milling. Milled products of other grains, such as rye, buckwheat, rice, and corn, and of plants such as the Irish potato, are also referred to as flour, but unqualified use of the term refers only to flour made from grains of common or bread wheat, *Triticum aestivum* or *vulgare*.

FLOUR

Flour contains from 65 to 70 percent starch, but its most important nutrient value lies in its protein content of 9 to 14 percent. Gliadin and glutenin are the principal proteins, constituting approximately 80 percent of the gluten. Cellulose, fats, and sugar total less than 4 percent.

Milling Processes. Cereal grains were an important article of food in prehistoric times. They were originally eaten unground and uncooked, and the earliest reference to ground wheat dates back to ancient Egyptian times. In the earliest milling process, grain was broken into coarse fragments by a mortar and pestle. The earliest device for producing flour consisted of two roughened grinding surfaces, called millstones, between which grain was reduced to a powder. Until the substitution of rollers for stones in the grinding process, the adaptation of newly discovered sources of power constituted the only significant change in milling.

Present-day milling processes begin with the cleaning of kernels. Wheat arriving at a mill is generally mixed with such matter as straw, chaff, pebbles, earth, and seeds of various kinds. Coarse and fine material is removed by passing the wheat through sieves, but seeds and other objects that approximate wheat grains in size must be extracted by special means. Cylinders and disks that have perforations of various sizes not only separate remaining foreign particles, but segregate wheat kernels by size. Next, the wheat is scoured by being passed through an emery-lined cylinder. Tempering, a process by which the moisture content is adjusted for easiest separation of kernel from husk, is the last step in preparing the grain for grinding.

Because of the development of wheat varieties that do not require the heavy friction provided by millstones, most grinding is done in roller mills. Corrugated rollers gradually reduce wheat kernels to powder, effecting separation of kernel and husk. Initial rolling takes place in three to six stages, the last stage of which yields bran, middlings, and flour. Finished flour consists almost entirely of endosperm, or nutritive tissue. Middlings are composed of fragments of endosperm, fragments of husk, and husk fragments with adhering particles of endosperm. Bran, the broken husk of the grain, is used as feed for livestock and to provide roughage in some breakfast cereals.

Between each of the stages of rolling, and following the final stage, the ground product is sifted, a process referred to by millers as bolting. Three types of sifters are in common use: the Plansifter, composed of a series of sieves arranged one above another; the reel, covered

with silk bolting cloth or wire of a gauge that retains middlings; and the centrifugal, an adaptation of the reel equipped with beaters that hurl the product the length of the reel.

The finest grades of flour are obtained from the middlings that are left over from the bolting process. The flour is extracted by a process called purification. A purifying machine is usually a sieve through which a stream of air is passed, separating the flour particles by passage through the meshes of the sieve and by flotation in air.

The grades of flour removed at successive stages of the milling process vary widely. For commercial purposes the milling grades are blended to produce standard grades or special commercial brands. The standard grades, in order of quality, are first patent, second patent, first clear, second clear, and red dog. Standard patent flour, sometimes called straight grade, is a blend of patent and first clear grades. Most bread flour sold today is so-called enriched flour, which consists of ordinary white flour with added vitamin B₁, niacin, riboflavin, and iron, giving it the same vitamin content as whole flour.

The yellowish color of unbleached flour is caused by the presence of small quantities of the pigment carotin, from which vitamin A is synthesized. Most consumers, however, prefer flour that has as little color as possible. The bleaching agents most commonly used are chlorine dioxide, nitrogen trichloride, and nitrogen tetroxide. Although bleaches are harmless in the proportions remaining in the finished flour, all bleached flour intended for distribution in the United States must be labeled as such.

Quality of Flour. The general characteristics of wheat, such as weight per unit volume, size of kernels, plumpness, and absence of blemishes, all affect flour and can be observed by gross inspection. The commercial value of flour, however, is best measured through the study of more specific properties, such as moisture content, acidity, amount of protein, water-absorption capacity, degree of granulation, color, fat content, and the expansive quality of gluten.

Self-Rising Flour. The constituents of baking powder, which is used to raise certain types of dough, do not produce the necessary carbon-dioxide gas except in the presence of water. Combination of baking powder with dry flour to produce a self-rising dough is therefore possible. The proportion of baking powder used must be carefully controlled, because the expansibility of the dough must not be exceeded by the amount of gas produced.

Brown Wheat Flour. The product sold as whole-wheat flour in the U.S. contains all of the kernel with the exception of the bran. Graham flour, named for the American food-reform advocate Sylvester Graham (1794–1851), contains the rolled but unbolted product of the entire wheat kernel. Many flours marketed as graham are imitations, containing inferior grades of flour mixed with bran. The brown flours are slightly superior to patent flours in chemical composition of nutrients, but extensive experimentation has shown them to be inferior in digestibility.

Production. The U.S. is second to the Soviet Union in the production of flour (1,061,500,000 tons). Kansas is the leading State in flour production. In 1968 the U.S. per capita consumption of flour (including white, whole wheat, and semolina flour) was 109 lb.

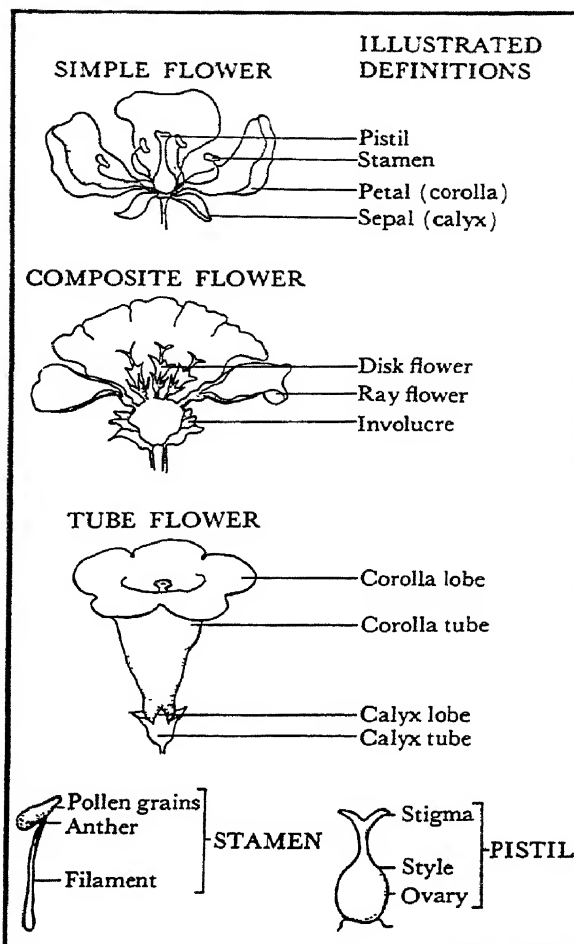
See also BREAD; WHEAT.

FLOWER, reproductive organ of an angiosperm plant that produces fruits containing seeds; see BOTANY: *Classification*. Not all seed plants have flowers; conifers, for example, produce seeds on scales united to form a cone.

Parts of a Flower. Every flower is a terminal branch consisting of a modified stem, the floral axis, or receptacle. The floral axis bears one to four types of specialized appendages, or modified leaves, usually arranged in whorls, or circles, in the more advanced flowers, and spirally arranged in the more primitive ones. In a typical flower the outermost whorl, the calyx, consists of a number of sepals which protect the flower bud before blooming. The next whorl on the floral receptacle, the corolla, is composed of a number of petals, often bearing nectar-producing glands that aid in attracting pollinators; see NECTAR; POLLINATION. The next whorl, called the androecium, consists of a number of stamens which produce the pollen necessary for reproduction in anthers. There may be two whorls of stamens. The innermost or highest whorl, called the gynoecium, consists of several carpels frequently completely fused to form a pistil. Each carpel contains at least one placenta to which are attached ovules, or immature seeds; see OVULE. The calyx and corolla are collectively known as the perianth.

Flowering plants are divided into two major classes, the Dicotyledonae and the Monocotyledonae. Among the dicotyledons, floral organs in multiples of five or four are more frequently encountered, while among the monocotyledons, floral organs in multiples of three are usual.

Types of Flowers. The majority of angiosperm species bear flowers that deviate in some re-

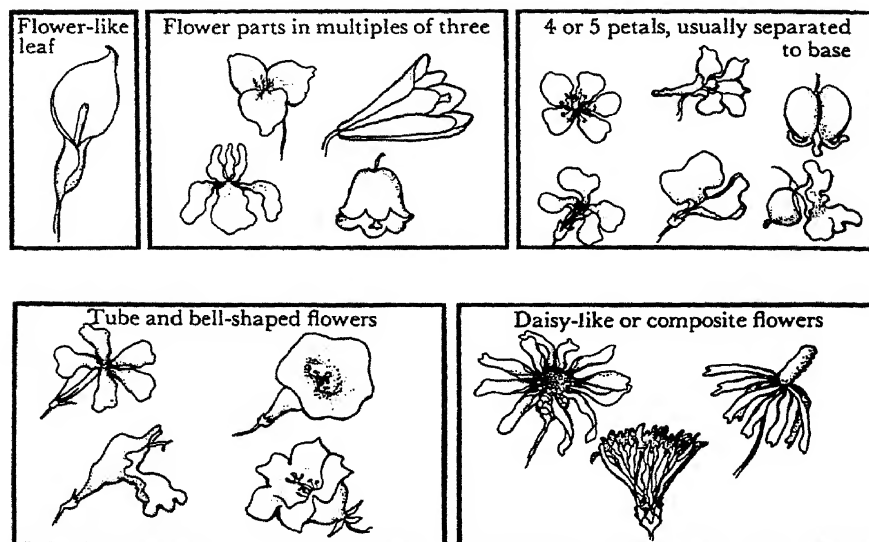


From *The Flower Family Album* by Helen Field Fisher and Gretchen Harshbarger, University of Minnesota Press, Minneapolis, © 1941, University of Minnesota

spects from the norm described above. Flowers that bear sepals, petals, stamens, and carpels are termed complete; a flower lacking any of these whorls is called incomplete. If the parts involved in reproduction, the stamens or pistils, are lacking, the flower is said to be imperfect. It is a perfect flower if all reproductive organs are present. If only pistils are present the flower is said to be pistillate; with stamens only, staminate. Typical flowers are bisexual. When staminate and pistillate flowers occur on one plant it is said to be monoecious; when they occur on different plants, dioecious.

In many flowers, sepals and petals are uniform in size and arranged in a star-shaped, or radially symmetrical form. Bilaterally symmetrical flowers, however, have petals that differ in size or shape. The five petals of sweet pea (*Lathyrus odorata*), for example, include a large, showy banner, or standard petal; two smaller, winglike petals at the side of the flower; and between

FLOWER



From The Flower Family Album by Helen Field Fischer and Gretchen Harshbarger, University of Minnesota Press, Minneapolis, © 1941, University of Minnesota.

them the keel, two petals that encase the pistils and stamens. These are united along their edges. See also FLAG; IRIS; ORCHID.

Floral parts vary in their relative positioning. In a hypogynous flower the sepals form the lowest whorl, followed by successively higher whorls of petals, stamens, and pistils. In the perigynous flower, what is thought by some to be an extension of the floral axis forms a cup about the pistils; on the rim of the cup sit the other floral organs. In an epigynous flower the other

Although the orchid is an irregular flower, it is bilaterally symmetrical, that is, all the parts on one side have corresponding parts on the other.

John J. Simpkins -

National Audubon Society

floral organs appear to rise from the top of the ovary of the pistil. Evidence seems to indicate that the bases of the other floral organs are fused about the ovary and thus give the appearance that stamens, petals, and sepals arise from the top of the ovary.

Evolution of Flowers. Primitive flowers are thought to be those which have numerous parts, spirally arranged and separately attached to their floral axes. Flowers whose morphology varies from this condition are thought to be more advanced. Thus whorling, reduction of parts, fusion of parts, loss of parts, and bilateral symmetry indicate modification. It would seem that the flower in possession of all or any one of these characteristics is more advanced. If only one characteristic is present the flower is considered advanced for that characteristic alone. Buttercups and magnolias are among the most primitive plants on earth, while snapdragons, mints, composites (see COMPOSITAE) and orchids are among the most advanced, that is, more recently evolved.

The composite is a special case. The flower of the composite (a daisy, for example) is not a flower at all but a mass of many flowers called a head or capitulum. The petals of the daisy are not single petals but composed of five fused petals and are part of an entire, small, bilaterally symmetrical flower which is inserted at the rim of the head. The center of the daisy is composed of a few to many complete, perfect, radially symmetrical flowers with five fused petals shaped to form a tube.

Coloration of Flowers. Two types of pigments are responsible for the coloration of flowers. They are fat-soluble pigments contained in





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chromoplasts and water-soluble pigments contained within the vacuoles of the epidermal cells of the petals. All blues and purples seen among flowers are due to vacuolar pigments known as anthocyanins (q.v.). These will change color; if the vacuolar solution is basic they are blue, if neutral they are purple or violet, and if acid, red. Various shades depend on the degree of acidity or basicity, as well as on the type of anthocyanin pigment present. Reds may also be due to the presence of chromoplast pigments. Yellows are often due to the presence of flavones, as in the primrose (q.v.). The white appearance of petals is caused by numerous minute air pockets between the cells of the petals.

Flower Fragrance. The fragrance of flowers is caused by minute quantities of volatile oils formed by the alteration of essential oils (q.v.) in petals. Natural perfumes are made from hyacinth, heliotrope, mimosa, jasmine, orange, rose, and violet (qq.v.), among others. The various fragrances attract pollinators to the flower. Some flowers give off evil odors, again to attract their pollinators, usually the housefly or a fly relative. Such flowers are called carrion flowers and usually smell like rotting flesh. Carrion flowers are not limited to any one family or order among the flowering plants.

See HORTICULTURE.

L.J.C.

FLOWER-DE-LUCE. See IRIS.

FLOWERING MAPLE. See ABUTILON.

FLOWERING PLANTS, name applied to the angiosperms, the closed ovaries of the majority of which bear seeds that develop into fruits; see BOTANY: *Classification*. The group is characterized by the possession of true flowers, which are lacking in some seed plants such as conifers; see FLOWER. A true flower is to be distinguished from an inflorescence (q.v.), which is not a true floral organ, but an aggregation of small flowers.

Left: The daisy is not a single flower, but rather a composite of a center cluster of disk flowers surrounded by ray flowers. Above: The cactus dahlia is a regular flower characterized by long, curling, raylike petals.

FLOWERS, SYMBOLIC USE OF, flowers used as national and religious symbols and as symbolic expressions of human sentiment. Floral symbols were used extensively in the writings and inscriptions of antiquity. The Old Testament, for example, contains many allusions to flowers, notably in the Song of Solomon (q.v.). Inscriptions on some Egyptian monuments were carved in a floral code in which the Egyptian lotus, the sacred water lily, played a prominent part. The Indian lotus was sacred to the Hindus, who believed that the god Brahma (q.v.) was born in it; it acquired an aura of religious mystery and was frequently used for architectural adornment. In Japan, the lotus was a symbol of purity. The national flower of Japan was, however, the large chrysanthemum that was native to eastern Asia; the flower was used as a royal crest for governmental documents, was embroidered on flags and banners, and was printed on important papers. The Japanese royal family used the leaves and buds of the paulownia, or kiri tree, as its crest; two of the highest honorary orders of Japan were established as the Order of the Chrysanthemum and the Order of the Kiri Sun. A love and regard for flowers was shown in many other Oriental countries. In India, special honor for a guest was shown by wreathing his neck with flowers. Among the Arabs and the Seljuk Turks, writing and speech were full of floral symbols.

Flowers have also played a part in the customs of Western civilizations. The ancient Greek city of Athens used the violet as its emblem. Laurel and buckthorn hung over a Greek doorway meant that an occupant of the house was ill. A lover decorated his beloved's doorway with garlands of flowers. During times of rejoicing,

FLOWERS, SYMBOLIC USE OF

Greek cities hung garlands of flowers from their gates. Victors in the Greek public games were rewarded with floral emblems, notably in the Olympian games, where the champion was crowned with wild olive. In ancient Rome, the highest honor that could be given to a soldier was the civic crown made of oak leaves; see **CROWN**. The Floralia, a festival in honor of the goddess Flora (q.v.), lasted five days, in late April and early May. A Roman bride wore a wreath, and the doorway of a bridegroom's house was adorned with flowers. Births were announced by sending flowers, and the biers of the dead were strewn with them. The rose was regarded as a symbol of secrecy: when, at banquets, a rose was suspended over the table, the guests knew that all conversation would be held in confidence, or *sub rosa* ("under the rose"). Moreover, the ancient Greeks and Romans developed intricate flower languages; see *Language of Flowers*, below.

Medieval Symbolism. In the Middle Ages, flowers played important roles as political emblems and symbols. From the time armorial bearings were first worn, about the 12th century, conventionalized flower forms were incorporated into heraldry. The most popular of these forms was the fleur-de-lis (q.v.), that became the personal emblem of the kings of France about 1180. Flowers were also used as the badges of partisans in political struggles. In the long struggle between the Imperialists and the pope in medieval Italy, supporters of the Ghibellines were known by their white lilies and supporters of the Guelphs, by red lilies; see **GUELPHS AND GIBELLINES**. One of the best-known political floral emblems was the English rose. Edward I (q.v.), Plantagenet King of England in the 13th century, was the first English monarch to take the red rose as his personal emblem; his brother, Edmund, Earl of Lancaster (see **LANCASTER, HOUSE OF**), also adopted the red rose as an emblem and, from that time on, the red rose remained the emblem of the House of Lancaster. In the 14th century Edmund of Langley, 1st Duke of York (1341–1402) the fifth son of Edward III (q.v.), Plantagenet King of England, adopted the white rose as the emblem of the House of York; see **YORK, HOUSE OF**. These badges assumed a deep significance during the 15th century, when the houses of York and Lancaster fought the Wars of the Roses for the throne of England; see **ROSES, WARS OF THE**. After the conclusion of these wars in 1485, the two houses were united by marriage; the red and white roses were combined to form a heraldic symbol called the Tudor rose, which was the royal em-

blem of England until James I (q.v.), first Stuart king of England, came to the throne. James united the English rose to the thistle, the national emblem of Scotland, and variations of that emblem were used by British rulers until the death in 1714 of Queen Anne (q.v.). Later British rulers used no personal emblem, and the rose became the national symbol of England.

Use of Floral Emblems. Tradition surrounds the national floral symbols of many countries. The cornflower, or Kaiserblume, became the national flower of Germany reputedly because Louise of Mecklenburg-Strelitz, Queen of Prussia (1776–1810), when fleeing from Berlin after its occupation by Napoléon I (q.v.), Emperor of France, in 1806, comforted her children by weaving garlands of cornflowers. Other national floral emblems adopted through tradition, are the lily of Italy and the tulip of the Netherlands.

Countries in the Western Hemisphere have also adopted floral emblems. Mexico, for example, chose the nopal cactus, or prickly pear, the subject of an old Aztec legend. The United States has no generally accepted national flower. In 1889 an attempt was made to secure a popular opinion in favor of some one flower; the goldenrod won the competition, but it has never been generally recognized or accepted. The legislatures of the various States have, however, adopted State flowers; see articles on the various States.

Language of Flowers. The Greeks were the first people to use a flower language, in which different flowers represented specific emotions or ideas. They developed this language to a high degree. The Romans also used a well-developed flower language, and its study was revived during the Middle Ages, in connection with chivalry (q.v.).

In Oriental countries, flower languages have been developed that are capable of expressing subtle nuances of love and desire. One intricate variety of flower language is a method of sending flowers the names of which, in Arabic or Turkish, rhyme with the words a lover really wishes to convey. At one time, China had a complete floral alphabet.

In the flower language (or florigraphy) that has been handed down in Western civilizations, the significance of many flowers is derived from their properties. The amaranth, for example, means immortality because its bloom lasts for a long period; and an imaginary flower, called the amaranth by poets, was supposed never to fade. A notable use of flower language was made by the English dramatist William Shakespeare (q.v.)

in Act IV, Scene 5 of *Hamlet*, when the character Ophelia speaks of the meanings of the flowers she is carrying. Florigraphy was used to a great extent in Europe and the U.S. during the 19th century, when extreme refinements of sentiment were popular.

FLOYD, John Buchanan (1806–63), American politician and Confederate army officer, born in Smithfield, Va., and educated at South Carolina College (now University of South Carolina). He was elected to the Virginia state assembly in 1847 and became governor in 1849. For aid in the election of James Buchanan (q.v.) as President of the United States, Floyd was appointed secretary of war in 1857. He advocated states rights, but opposed secession (qq.v.). The secession of South Carolina on Dec. 20, 1860, the occupancy of Fort Sumter (q.v.) on Dec. 26, and Buchanan's refusal to order its evacuation turned Floyd into a strong secessionist, and he resigned on Dec. 29. Floyd was persecuted following his withdrawal. Buchanan accused him of misusing \$870,000 of government funds, but the government could not sustain the charge. He was also accused of having strengthened the South by transferring arms from northern arsenals, a charge quashed by a congressional committee.

Appointed a brigadier general in the Confederate army in 1861, Floyd was ordered to command Fort Donelson (see FORT DONELSON NATIONAL MILITARY PARK). He arrived there after General Ulysses Simpson Grant (q.v.) had brought it under siege. Although penned within his own lines and outnumbered almost two to one, Floyd disagreed with the decision to surrender. He turned the command over to Major General Simon Bolivar Buckner (q.v.), who later surrendered the fort, and escaped with 1200 men by steamer. For this, Jefferson Davis (q.v.), President of the Confederate States of America, an old foe, stripped Floyd of command. Floyd was vindicated by appointment as a major general by the Virginia assembly.

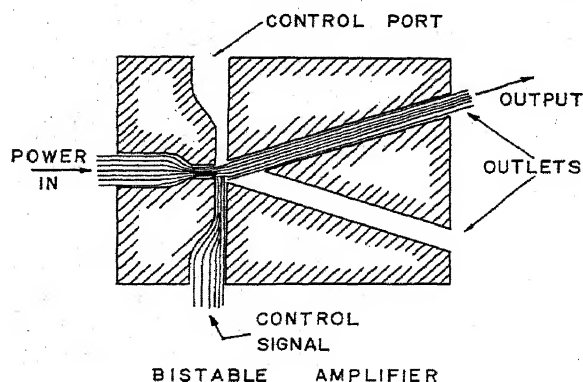
FLU, colloquial abbreviation for influenza (q.v.).

FLUID, substance that yields readily to any force that alters its shape; thus, it conforms to the configuration of a containing vessel. Fluids are either liquid or gases and, with solids, are the most important states of matter; see MATTER, STATES OF. The particles composing a fluid are not rigidly adherent to each other, but are held together more closely than those of a gas. Thus, the volume of a liquid remains unaltered in a sealed container and has a definite surface boundary. In contrast, a gas has no natural

boundary and expands and diffuses into air, diminishing in density. It is difficult to distinguish between solids and fluids, since even rocks and glaciers flow under favorable conditions. The distinction between a liquid and a gas is equally uncertain; liquid water evaporates to a gas and freezes to solid ice, and air can be liquefied under compression. See CAPILLARITY; CRITICAL POINT; CRYOGENICS; EVAPORATION; GAS, PROPERTIES OF; HYDROMECHANICS; OSMOSIS; STEAM AND STEAM ENGINEERING; VAPOR; WATER.

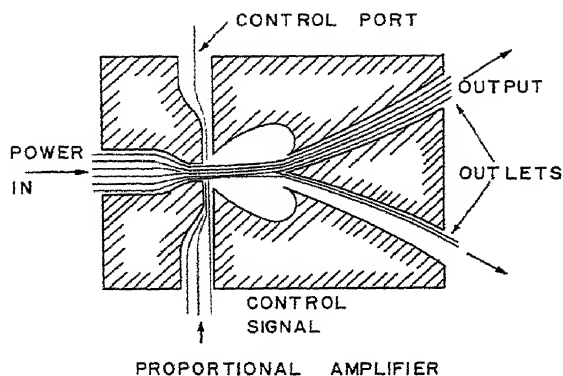
FLUIDICS, in engineering, the measurement or control of equipment by fluid jet devices. The basic element of control is a fluid amplifier in which a small signal delivered by a minute flow of gas or liquid can be greatly amplified to deliver mechanical power. Its function is similar to that of the electronic amplifier except the fluid amplifier makes available direct mechanical power, and the electronic amplifier produces an electric signal; see AMPLIFIER; ELECTRONICS.

Two basic elements of the fluid amplifier, the bistable and the proportional amplifier, were invented in 1959. In the bistable amplifier the signal is applied to one control port (see illustration), thus flipping the main jet flow through



the outlet port on the other side. The output jet direction will be maintained until a control signal is applied at the other port. The bistable amplifier thus provides a switching system and combinations of amplifiers can be hooked together to provide complex control systems. In the proportional amplifier (see illustration), signals are supplied to both control ports and the resulting jet flow through the single output port is proportional to the difference of the control signals.

Fluidic devices are used to check weights, measure flow rates, provide on-off controls, and to operate various types of production machinery. If used with a chemically inert gas (see INERT GASES), such as nitrogen or helium, these de-



PROPORTIONAL AMPLIFIER

vices are especially advantageous in cases where fire or electrical hazards are present, as in the manufacture of explosives (q.v.). Frequently, the fluid to be controlled is also used directly in a fluid amplifier. Thus, water-operated elements can be employed to control the large water flows needed in the chemical or paper-manufacturing industry.

Fluidic elements are limited in their response time, which is generally above 0.001 sec. In high-speed switching operations, such as those required in computers, these fluidic devices are not as efficient as electronic equipment which can operate at speeds of 10^{-9} sec.; see COMPUTER.

FLUID MECHANICS, physical science dealing with the action of fluids at rest or in motion, and with applications and devices in engineering using fluids. Fluid mechanics is basic to such diverse fields as aeronautics (see AIRPLANE; AVIATION), chemical, civil and mechanical engineering (see under ENGINEERING), meteorology, naval architecture (qq.v.) and oceanography; see OCEAN AND OCEANOGRAPHY.

Fluid mechanics can be subdivided into two major areas, fluid statics which deals with fluids at rest, and fluid dynamics, concerned with fluids in motion. The term hydrodynamics is applied to the flow of liquids or to low-velocity gas flows where the gas can be considered as being essentially incompressible. Aerodynamics (q.v.) is primarily concerned with the theory of flight (see FLIGHT, THEORY OF), and compressible fluid flow or gas dynamics with the behavior of gases under flow conditions, where velocity and pressure changes are large enough to require inclusion of the compressibility effects.

Applications of fluid mechanics involve all kinds of flow machinery, including jet propulsion, hydraulics, pumps and pumping machinery, turbine (qq.v.), and compressors. Hydraulics is primarily concerned with machines and structures such as hydraulic turbines, dams, and hydraulic presses, using water or other liquids.

FLUID STATICS OR HYDROSTATICS

This is the simplest area of fluid mechanics. A fundamental characteristic of any fluid at rest is that the force exerted on any particle within the fluid is the same in all directions. If the forces were unequal, the particle would move in the direction of the resultant force. It follows that the force per unit area, or the pressure exerted by the fluid against the walls of an arbitrarily shaped containing vessel, is perpendicular to the interior walls at every point. If the pressure were not perpendicular there would be an unbalanced tangential force component and the fluid would move along the wall.

This concept was first formulated in a slightly extended form by the French mathematician and philosopher Blaise Pascal (q.v.) in 1647. Known as Pascal's law, it states that the pressure applied to an enclosed fluid is transmitted equally in all directions and to all parts of the enclosing vessel, if pressure changes due to the weight of the fluid can be neglected. This law has extremely important applications in hydraulics.

The top surface of a liquid at rest in an open vessel will always be perpendicular to the resultant forces acting on it. If gravity is the only force, the surface will be horizontal. If other forces in addition to gravity act, then the "free" surface will adjust itself. For instance, if a glass of water is spun rapidly about its vertical axis, both gravity and centrifugal forces will act on the water and the surface will form a parabola which is perpendicular to the resultant force. This characteristic has been used to form parabolic telescope mirrors by rotating a shallow pan of mercury.

If gravity is the only force acting on a liquid contained in an open vessel, then the pressure at any point within the liquid is directly proportional to the weight of a vertical column of that liquid. This, in turn, is proportional to the depth below the surface and is independent of the size or shape of the container. Thus the pressure at the bottom of a pipe 1 in. in diameter and 50 ft. high that is filled with water is the same as the pressure at the bottom of a lake 50 ft. deep. Similarly, a pipe 100 ft. long which is filled with water, and slanted so that the top is only 50 ft. above the bottom vertically, will have the same pressure exerted at the bottom of the pipe even though the distance along the pipe is much longer. The weight of a column of fresh water 1 ft. high and with a cross section of 1 sq.in. is 0.433 lb., and this will be the pressure exerted at the bottom. A column 1 ft. high and 1 sq.ft. in cross section will weigh 144 times as much, but

the pressure, which is force per unit area, will remain identical. The pressure at the bottom of a mercury column 1 ft. high will be $0.433 \times 13.6 = 5.89$ lb. per sq.in. as mercury is 13.6 times as heavy as water.

The air pressure exerted at the surface of the earth is the result of the weight of the atmospheric air column above it. At sea level, under standard atmospheric conditions, the pressure equals 14.696 lb. per sq.in. This is equivalent to the pressure exerted by a column of mercury 29.92 in. (or 760 mm) high, thus giving rise to the normal barometric pressure which is usually given in inches of mercury; *see* ATMOSPHERE; BAROMETER.

The second important principle of fluid statics was discovered by the Greek mathematician and philosopher Archimedes (q.v.). The so-called Archimedes' principle states that a submerged body is subject to a buoyancy force which is equal to the weight of the fluid displaced by that body. This explains why a heavily laden ship floats; its total weight equals exactly the weight of the water that it displaces, and this weight exerts the buoyant force supporting the ship. The equality of the buoyant force and the weight also explains the ability of a submarine to stay submerged and of a balloon to float in air where its weight equals that of the displaced air. Archimedes' principle also makes possible the determination of the density of an object that is so irregular in shape that its volume cannot be measured directly. If the object is weighed first in air and then in water, the difference in weights will equal the weight of the volume of the water displaced, which is the same as the volume of the object. Thus the weight density of the object (weight divided by volume) can readily be determined. In very high precision weighing, both in air and in water, the displaced weight of both the air and water has to be accounted for in arriving at the correct volume and density.

FLUID DYNAMICS OR HYDRODYNAMICS

This branch of fluid mechanics deals with the laws of fluids in motion; these laws are considerably more complex and, in spite of the greater practical importance of fluid dynamics, only a few basic ideas can be discussed here.

Interest in fluid dynamics dates back to the earliest engineering application of fluid machines. Archimedes made an early contribution by his invention of the screw pump, the pushing action of which is similar to that of the corkscrew-like device in a meat grinder. Other hydraulic machines and devices were developed by the Romans, who not only used Archimedes'

screw for irrigation and mine pumping but also built extensive aqueduct systems, some of which are still in use. The Roman architect and engineer Marcus Vitruvius Pollio (q.v.) invented the horizontal waterwheel during the 1st century B.C., which revolutionized corn milling.

In spite of the early practical applications of fluid dynamics, there was little or no understanding of the basic theory, and development lagged accordingly. After Archimedes, more than 1800 years elapsed before the next significant scientific advance was made by the Italian mathematician and physicist Evangelista Torricelli (q.v.), who invented the barometer in 1643, and formulated Torricelli's law which related the efflux velocity of a liquid through an orifice in a vessel to the liquid height above it. The major spurt in the development of fluid mechanics had to await the formulation of Newton's laws of motion by the English mathematician and physicist Isaac Newton (qq.v.). These laws were applied to fluids first by the Swiss mathematician Leonhard Euler (q.v.) who derived the basic equations for a frictionless, or inviscid fluid, which still bear his name.

Euler first recognized that dynamical laws for fluids can only be expressed in a relatively simple form if the fluid is assumed incompressible and ideal, that is, if the effects of friction or viscosity can be neglected. Because, however, this is never the case for real fluids in motion, the results of such an analysis can only serve as an approximation for those flows where viscous effects are small.

Incompressible and Inviscid or Frictionless Flows. These flows follow Bernoulli's principle, named after the Swiss mathematician and scientist Daniel Bernoulli; *see under* BERNOULLI. The principle states that the total mechanical energy of an incompressible and inviscid flow is constant along a streamline. Streamlines are imaginary flow lines that are always parallel to the local direction of the flow, and that for steady flow, are also the lines followed by individual fluid particles. Bernoulli's principle leads to an interrelationship between pressure effects, velocity effects, and gravity effects, and indicates that the velocity increases as the pressure decreases. This principle is important in nozzle design, in flow measurements, and it can also be used to predict the lift of a wing in flight.

The theory of incompressible and inviscid flows are highly developed by some of the foremost mathematicians during the first half of the 19th century; they were not bothered by the fact that their results had little value for the pri-

mary engineering applications that were concerned with flow studies for water-supply systems, where viscosity could not be neglected.

Viscous Flows, Laminar and Turbulent Motion. The first carefully documented friction experiments in low speed pipe flow were carried out independently in 1839 by the French physiologist Jean Leonard Marie Poiseuille (1799–1869), who was interested in the characteristics of blood flow, and in 1840 by the German hydraulic engineer Gotthilf Heinrich Ludwig Hagen (1797–1884). An attempt to include the effects of viscosity into the mathematical equations was made first in 1827 by the French engineer Claude-Louis-Marie Navier (1785–1836), and independently by the British mathematician Sir George Gabriel Stokes (q.v.), who in 1845 perfected the basic equations for viscous incompressible fluids. These are now known as the Navier-Stokes equations, and they are so complex that they can be applied only to simple flows. One such flow is that of a real fluid through a straight pipe. Here Bernoulli's principle is not applicable because part of the total mechanical energy is dissipated as a result of viscous friction, resulting in a pressure drop along the pipe. The equations suggest that this pressure drop for a given pipe and a given fluid should be linear with the flow velocity. Experiments first conducted near the middle of the 19th century showed that this was only true for low velocities; at higher velocities, the pressure drop was more nearly proportional to the square of the velocity. This problem was not resolved until the British engineer Osborne Reynolds (1842–1912) showed in 1883 that there were two types of viscous flows in pipes. At low velocities the fluid particles follow the streamlines (laminar flow) and results match the analytical prediction. At higher velocities the flow breaks up into a fluctuating velocity pattern or eddies (turbulent flow) in a form that cannot be fully predicted even today. Reynolds also established that the transition from laminar to turbulent flow was a function of a single parameter which has since become known as the Reynolds number. If the Reynolds number, which is the product of velocity, fluid density and pipe diameter divided by the fluid viscosity, is less than 2100, the pipe flow will always be laminar; at higher values it will normally be turbulent. The concept of a Reynolds number is basic to much of modern fluid mechanics.

Turbulent flows cannot be evaluated solely from computed predictions and depend on a mixture of experimental data and mathematical models for their analysis, with much of modern

fluid-mechanics research still being devoted to better formulations of turbulence. The transitional nature from laminar to turbulent flows and the complexity of the turbulent flow can be observed as cigarette smoke rises into very still air. At first it rises in a laminar streamline motion but after some distance it becomes unstable and starts to break up into an intertwining eddy pattern.

Boundary Layer Flows. Prior to about 1860 the engineering interest in fluid mechanics was limited almost entirely to water flows. The development of the chemical industry during the latter part of the 19th century directed attention to other liquids and to gases. Interest in aerodynamics began with the studies of the German aeronautical engineer Otto Lilienthal (q.v.) in the last decade of the 19th century, and saw major advances following the first successful powered flight by the American inventors Orville and Wilbur Wright (*see under* WRIGHT) in 1903.

The complexity of viscous flows, especially turbulent flows, severely restricted progress in fluid dynamics until the German engineer Ludwig Prandtl (1875–1953) recognized in 1904 that many flows could be divided into two principal regions. The region close to the surface consists of a thin boundary layer where the viscous effects are concentrated and where the mathematical model can be greatly simplified. Outside the boundary layer viscous effects can be disregarded and the simpler mathematical equations for inviscid flows can be used. The boundary-layer theory has made possible much of the development of modern aircraft wings and the design of gas turbines and compressors. The boundary layer model not only permitted a much simplified formulation of the Navier-Stokes equations in the region close to the body surface but also led to further developments of the flow of inviscid fluids which can be applied outside of the boundary layer. Much of the modern development of fluid mechanics was made possible by the boundary layer concept and it has been carried out by such key contributors as the Hungarian-born American aeronautical engineer Theodor von Kármán (q.v.), and the German mathematician Richard von Mises (1883–1953), and by the British physicist and meteorologist Sir Geoffrey Ingram Taylor (1886–1975).

Compressible Flows. Interest in compressible flows started with the development of steam turbines by the British inventor Sir Charles Algernon Parsons (1854–1931), and the Swedish engineer Carl Gustaf Patrik de Laval (1845–

1913) during the 1880's. Here high speed flow of steam within flow passages was first encountered and the need for efficient turbine design led to improved compressible flow analyses. Modern developments, however, had to wait for the stimulus of successful gas turbine and jet engine development in the 1930's. The early interest in high speed flows over surfaces arose in the study of ballistics (q.v.) for which an understanding of the motion of projectiles was needed. Major developments started near the end of the 19th century, involving Prandtl and his students among others, and have increased since the development of high speed aircraft and rockets (see ROCKET) during World War II.

One of the basic principles of compressible flows is that the density of a gas changes when the gas is subjected to large velocity and pressure changes. At the same time its temperature also changes, leading to more complex means of analysis. The flow behavior of a compressible gas depends on whether the flow velocity is smaller or greater than the velocity of sound. The velocity of sound is the name given to the propagation velocity of a very small disturbance, or pressure wave, within the fluid. For a gas it is proportional to the square root of the absolute temperature. For instance, air at 60° F., or 520° Rankine (on the absolute scale), has a sound velocity of 1120 ft. per sec. If the flow velocity is less than the sound velocity (subsonic flow), pressure waves can be transmitted throughout the whole fluid to adjust the flow that rushes toward an object. Thus the subsonic flow approaching an airplane wing will adjust itself some distance upstream to flow smoothly over the surface. In supersonic flow, pressure waves cannot travel upstream to readjust the flow. As a result, the air rushing towards a wing in supersonic flight will not be prepared for the impending disturbance caused by the wing. Instead, it has to redirect very suddenly in the proximity of the wing, where a sharp compression or shock is coupled with the redirection. The noise associated with this sudden shock causes the sonic boom of aircraft flying at supersonic speeds. Compressible flows are often identified by the Mach number, which is the ratio of the flow velocity divided by the sound velocity; see MACH, ERNST. Supersonic flows therefore have a Mach number greater than 1. See SUPERSONICS.

F.La.

FLUKE, common name given to flatworms belonging to the class Trematoda; see FLATWORM. Flukes are all parasitic, and vary in length from 0.2 mm. to 165 mm. (0.008 in. to 6.5 in.). Most species have flat, elongated bodies; some of the

blood flukes approach a cylindrical shape. The possession of a digestive tract, specialized sensory organs, and in most species free-living stages, places them closer to the free-living flatworms than to the parasitic tapeworms in their evolutionary history. The mouth of the fluke is situated on the underside and in most species near the front. Muscular sucking disks, which serve to attach the fluke to the host, are always present; in the species which are external parasites (ectoparasites), these suckers are often equipped with hooks. The digestive system may be tubular, forked, or multibranched. Muscular fibers are present under the cuticular epidermis and run in circular, diagonal, and longitudinal directions. These muscular fibers compose the locomotive system of the fluke. The excretory system varies in complexity with the size of the fluke, and is composed of star-shaped flame cells which connect with the openings to the exterior through tubules. In most species male and female organs are present in the same individual; see HERMAPHRODITISM. Flukes which are parasitic on the surface of other organisms have a simple development; species which are internal parasites (endoparasites) frequently undergo a complex development requiring several hosts to complete their life cycles.

An example of the endoparasite species is *Fasciola hepatica*, commonly called the sheep-liver fluke, which produces a disease in sheep, goats, and cattle called liver rot. This disease has a high mortality rate, and is frequently epidemic in Europe and Australia. The sheep-liver fluke is about 1 in. in length and is pigmented a dark red, much like the liver in which it lives. The eggs of this species leave the body of the sheep or other animal in the feces, and if they are discharged in a body of water hatch to liberate ciliated larvae, called miracidia. Each miracidium swims in the water until it finds a snail in which it can develop. The miracidium burrows its way to the liver tissue of the snail and changes into a spore form, or sporocyst. Within the sporocyst bodies called rediae develop by budding. These rediae produce more rediae which then produce new larval forms called cercariae. The cercaria escapes from the snail and attaches itself to some object, where it encysts. It remains encysted until a sheep or other mammal swallows it. The cyst wall then breaks down and the larva migrates to the liver of the host, where it develops into an adult fluke. The life cycle of this fluke is typical of the developmental history of many members of the class.

Flukes occur in most parts of the world where the hosts can thrive. They are parasitic in their

FLUORESCENCE AND PHOSPHORESCENCE

adult form in many species of vertebrate animals. Each species of fluke is host-specific (able to parasitize only a few related vertebrates). Flukes of the genus *Schistosoma*, commonly known as blood flukes, infest the blood vessels in man, causing the serious disease schistosomiasis (q.v.), also known as bilharzia disease.

The word fluke is also applied to several species of flatfish (see FLOUNDER), to either of the two horizontal lobes in which the tail of a whale (q.v.) terminates, and to the hooks of an anchor.

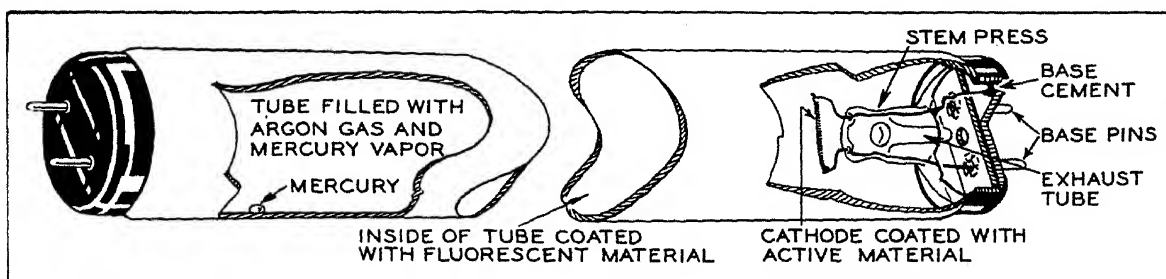
FLUORESCENCE AND PHOSPHORESCENCE, emission of light by certain materials as a result of their being exposed to some form of radiation, such as visible or ultraviolet light, X rays, gamma rays, or cathode rays (electron beams). Fluorescence is usually applied to luminescence occurring while the material is being irradiated, and phosphorescence to luminescence persisting after the source of radiation has been removed; fluorescence and phosphorescence, however, can occur separately or together. Light that is chemically produced, as in fireflies and rotting wood, is properly called chemiluminescence and not phosphorescence. See CATHODE RAYS; LIGHT; RADIOACTIVITY; ULTRAVIOLET RADIATION; X Ray.

To explain luminescence one uses the concepts of the quantum theory (q.v.), the particularly relevant features of which are that the electrons in molecules of solids, liquids, and gases possess a definite amount of energy relative to

this new energy state is a so-called allowed state of excitation, the electron can return to its unexcited state almost immediately, emitting its excess energy as a photon (q.v.) of light; this light is called fluorescence. If the improbable happens and an electron is excited into a state that is not allowed, then the theory dictates that the de-excitation is also disallowed. This means that the de-excitation of the electron, and hence the light emission, is delayed. This light is called phosphorescence. It often happens, therefore, that a phosphorescent material will continue to glow for a while after the excitation light is removed.

In either case of luminescence, because of dissipative processes, the light produced is almost always of lesser energy, that is, of longer wavelength, than the exciting light. The luminescence of materials, particularly those in practical use, is often due to specific chemical impurities that they contain. The luminescence in such a case is characteristic of the impurity. In certain gases and vapors, the wavelengths of the emitted and exciting light are the same.

Fluorescence and phosphorescence find a number of practical applications. The picture screens in television receivers are coated with fluorescent materials known as phosphors that glow when excited by a cathode ray; see ELECTRONICS. The interiors of fluorescent lamps have similar coatings, which absorb the invisible but intense ultraviolet components of the primary



Schematic drawing of a fluorescent tube.

General
Electric Co.

each other, and that the energy of an electron can be changed only by strictly prescribed amounts. Some energy changes or transitions are allowed, that is, are in accord with selection principles in physics, and some are not. Disallowed transitions can sometimes occur, but these are improbable events.

If a luminescent material absorbs the energy of suitable radiation, then, on a random basis, an electron in some molecule can become temporarily excited to a state with excess energy. If

light source and emit visible light. Phosphors are also utilized in a new form of electric lighting called electroluminescent panel lighting, in which an alternating current passed through the phosphor causes it to glow; see ELECTRIC LIGHTING. A mixture of a phosphor and a radioactive substance is used in the luminous paint on the dials and hands of watches and clocks; the emanations from the radioactive material cause the phosphor to become luminescent. The excitation of phosphors by high-energy rays is utilized in devices that detect nuclear particles; see SCINTILLATION COUNTER. A special type of fluorescence

called stimulated emission is demonstrated in the operation of a laser. M.Po.

FLUORIDATION. See DENTISTRY.

FLUORIDES. See FLUORINE.

FLUORINE (Lat. *fluo*, "flow"), element with at.no. 9, at.wt. 19.00, b.p. -188°C . (-306.4°F .), m.p. -220°C . (-364°F .), sp.gr. 1.696, and symbol F. Fluorine is a pale, greenish-yellow gas, slightly heavier than air, poisonous, corrosive, and of penetrating and disagreeable odor. It is the most chemically active of the nonmetallic elements and is a member of the halogen family. It combines directly with all the elements except nitrogen, chlorine, oxygen, and the inert gases such as helium and neon. Compounds of fluorine with nitrogen, chlorine, and oxygen can be formed indirectly. Nearly all compounds are decomposed by fluorine to form fluorides, and these fluorides are among the most stable of all chemical compounds. Fluorine was discovered by the Swedish chemist Karl Wilhelm Scheele in 1771; however, it was not isolated until 1886, by the French chemist Henri Moissan (qq.v.). He obtained the element by electrolyzing anhydrous hydrogen fluoride dissolved in acid potassium fluoride, which conducted the electric current. Although Moissan originally used vessels of platinum, containers made of other metals, such as copper, may be used.

Fluorine occurs naturally in the combined form as fluorite (or fluorspar), cryolite, and apatite (qq.v.). Fluorite, from which most fluorine compounds are generally derived, is commonly mined in the United States from large deposits in northern Kentucky and southern Illinois. Fluorine also occurs as fluorides in sea water, rivers, and mineral springs, in the stems of certain grasses, and in the bones and teeth of animals. It is the seventeenth element in order of abundance in the crust of the earth.

The preparation of fluorine as a free element is difficult, and fluorine is rarely employed in that form. Gaseous fluorine may be prepared by the Moissan electrolytic method; liquid fluorine may be prepared by passing the gas through a metal or rubber tube surrounded by liquid air.

Fluorine Compounds. Hydrofluoric acid (hydrogen fluoride, HF or H_2F_2), one of the most important fluorine compounds, is prepared by heating calcium fluoride in sulfuric acid. The aqueous solution of this acid, generally used commercially, is obtained by passing the anhydrous hydrogen fluoride vapors into a leaden receiver containing distilled water, thus yielding the acid in dilute form. Hydrofluoric acid is extremely corrosive and must be preserved in lead, paraffin, ceresin (a type of wax), or rubber

containers. Hydrofluoric acid has the property of dissolving glass, and this property is utilized in a common test for the presence of a fluoride; hydrofluoric acid is also used extensively in various forms of glass etching, such as the marking of divisions on thermometer tubes and the etching of designs on glassware, and in other forms of ceramic etching, such as pottery decoration.

Other fluorine compounds include hydrofluosilicic acid, which combines with bases to form salts called fluosilicates or silicofluorides, of which the most important are those of potassium and sodium.

Fluorine and many fluorides, such as hydrogen fluoride and sodium fluoride, are very poisonous. Drinking water containing excessive amounts of fluorides causes the enamel of the teeth to become brittle and to chip off, leaving a stained or mottled effect. However, the proper proportion of fluorides in drinking water has been found to reduce tooth decay substantially; see DENTISTRY.

Uses. Fluorine compounds have many applications. The chlorofluorocarbons, odorless and nonpoisonous liquids or gases such as Freon, are used as a dispersing agent in aerosol sprays and as a refrigerant. But with the discovery in 1974 that they reached the stratosphere and destroyed ozone, their continued use was in doubt; see AEROSOL. Teflon, a fluorine plastic that is extremely inert and very resistant to most chemical action, is widely used to make such products as motor gaskets and dashboard accessories in the automobile industry. Teflon is also used as a coating on the inner surface of frying pans and other kitchen utensils to eliminate the need for fat in cooking. Many organic fluorine compounds produced as a result of various kinds of research during World War II have been found to have extensive commercial potentialities. For example, the liquid fluorinated hydrocarbons derived from petroleum are useful as highly stable lubricating oils. Uranium hexafluoride, the only volatile compound of uranium, is employed extensively in the gaseous diffusion process to provide fuel for atomic-power plants.

See ISOTOPE.

FLUORITE or FLUORSPAR, common isometric mineral composed of calcium fluoride, the principal fluorine-bearing mineral. It is usually cubical when crystalline, and is also found in massive, granular, and columnar form. When pure, fluorite is colorless, transparent, or translucent, and has a glassy luster. It often occurs with impurities which make it yellow, blue,

FLUOROSCOPE

green, rose, or brown. Several varieties of fluorite exhibit fluorescence (q.v.).

The mineral is usually found either in pure veins or associated with lead, silver, and zinc ores. It is common in limestone and dolomites, and is occasionally found as an accessory mineral in pegmatites and other igneous rocks. Exceptionally clear crystalline fluorite is mined in Cumberland and Derbyshire, England, in the Alps of Switzerland, Austria, and Czechoslovakia, and in Norway. Commercially important deposits in the United States occur in a region on the Ohio R. which includes parts of Illinois and Kentucky.

Crystalline varieties, such as the fine-colored Derbyshire spar, are often carved into vases and other similar ornaments, and the variety chlorophane is used as a gem. The principal use of fluorite has been for the production of hydrofluoric acid (see FLUORIDE), an essential raw material in the manufacture of synthetic cryolite (q.v.) and aluminum fluoride for the aluminum industry, and in many others applications in the chemical industry. Fluorite is also a standard flux used in the making of steel. Large quantities of fluorite are used in the production of enamel and opal glass, and perfect crystals are used for the manufacture of apochromatic lenses.

FLUOROSCOPE, in medicine, apparatus for examining internal organs, used especially in diagnosis. The essential parts of the fluoroscope are an X-ray tube and a fluorescent screen. The subject to be diagnosed is placed between the X-ray tube and the fluorescent screen. Wherever the X-ray radiations fall on the screen, it glows vividly; where the X rays are reflected or absorbed, shadows are cast on the screen. Bones cast heavy shadows, and fleshy organs like the heart cast very light shadows. In stomach analysis bismuth salts are administered before examination. Because these salts are opaque to X rays, their passage through the alimentary canal can be traced. See X RAY.

FLUORSPAR. See FLUORITE.

FLUTE, musical instrument of the wind group of two principal types. The end-blown type,

known in ancient and medieval times, was made of wood and consisted of a cylindrical or conical tube with a mouthpiece located at the upper end. The body of the instrument had holes along its length, which were stopped by the fingers to produce the various notes. Because of the popularity of the end-blown flute in England from 1400 to 1700, it became known as the English flute. It survives today chiefly in the form of the recorder (q.v.).

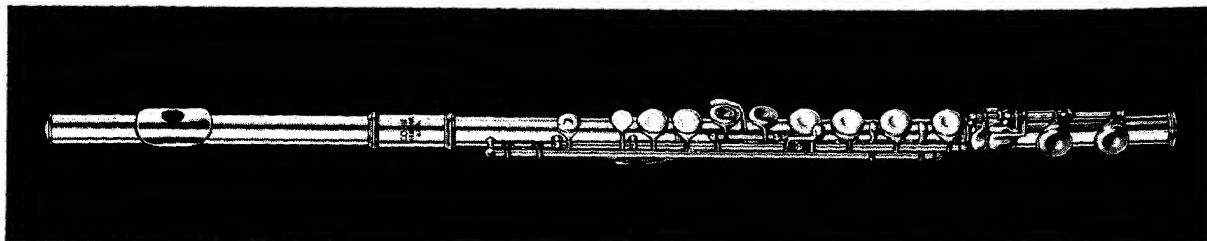
The transverse, or modern, flute is a hollow cylinder, generally made of silver, with an oval mouth-hole on the side, the embouchure. It has a greater number of holes along its body than the end-blown flute. These holes are stopped by the fingers or by keys manipulated by the fingers. In the modern flute the sound is produced when the air blown over the embouchure is broken against the opposite edge of the hole, causing the column of air inside the tube to vibrate. The various notes are produced by stopping the holes in the body of the instrument, thus changing the length of the column of air. The modern flute has a range of about three octaves above middle C and is held at right angles to the body. It was designed by a German musician and flutemaker, Theobald Boehm (1794–1881). In addition to the ordinary flute, two other types of transverse flute made today are the alto flute, which is larger than the ordinary flute and is tuned a fourth lower; and the piccolo, which is half the size of the ordinary flute and is tuned an octave higher.

The end-blown flute was known to the ancient Egyptians, Greeks, and Hebrews. From the 16th to the 18th centuries, it was used in early orchestras (see ORCHESTRA). During the 18th century two transverse flutes were usually used. Three to five differently tuned flutes are needed to perform some orchestral music of the 19th and 20th centuries. The flute is sometimes used in such chamber-music combinations as piano, violin, and flute, or harp and flute, and also as a solo instrument.

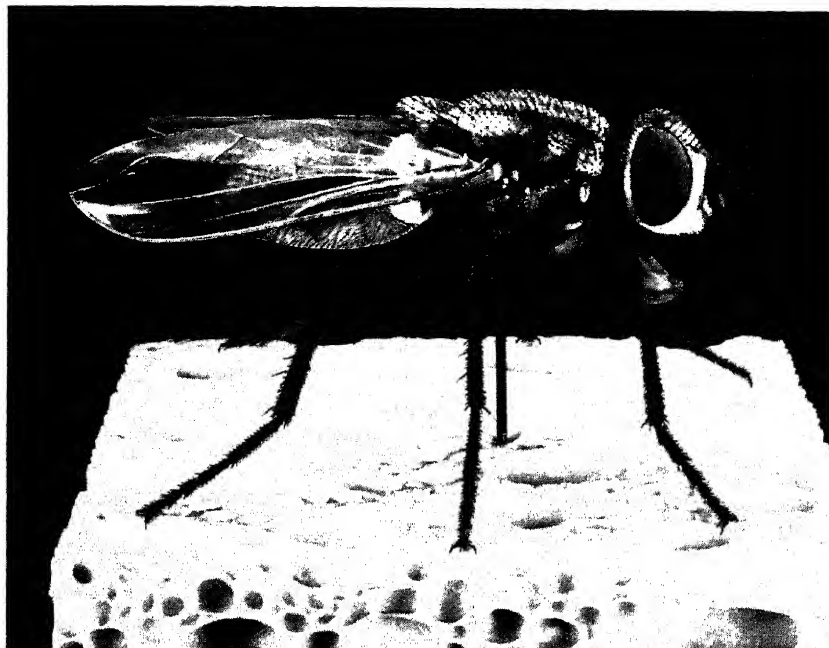
FLY, name loosely applied to winged forms of many kinds of insects, such as butterflies, dragonflies, mayflies, caddis flies, and true flies. The true flies, discussed here, are two-winged

A modern flute.

Conn Musical Instruments



Common housefly, *Musca domestica*
American Cyanamid Co.



insects belonging to the order Diptera (q.v.), of which 80,000 species of a possible million have been identified.

Most flies have spherical heads and large eyes with a compound sighting structure. Because of this structure flies may have compound, or mosaic, vision; see *EYE: Comparative Anatomy*. Flies also have antennae, a pair of long, moveable appendages on the head. These vary greatly with the species and are often used as a basis for classification. All flies have mouths that enable them to take in food through suction. In some, such as the female mosquitoes, these mouthparts also enable the insect to pierce skin in order to reach the blood below it. Some parasitic flies and certain other species do not have wings. True flies, however, have a pair of vestigial wings called halteres. These are used for maintaining balance, and without them directed flight is impossible. The males and females are difficult to distinguish. In males, the antennae are covered with hair, while the eyes may be enlarged to meet along the midline of the head. The tail section of the female is often equipped to deposit eggs.

There are two main suborders of flies, the Nematocera and the Brachycera, each containing a large number of families. The Nematocera are usually slender with long antennae; the larvae of this group possess large, distinct heads. Included in this suborder are the crane flies, mosquitoes, midges, gall gnats, fungus gnats, sand flies, and the blackflies or buffalo gnats. The Brachycera include flies with shorter anten-

nae; the larvae of this suborder have small heads that merge into their bodies. In this group are found the tabanids or horseflies, robber flies, bee flies, botflies, fruit flies, blowflies, tsetse flies, and the common housefly.

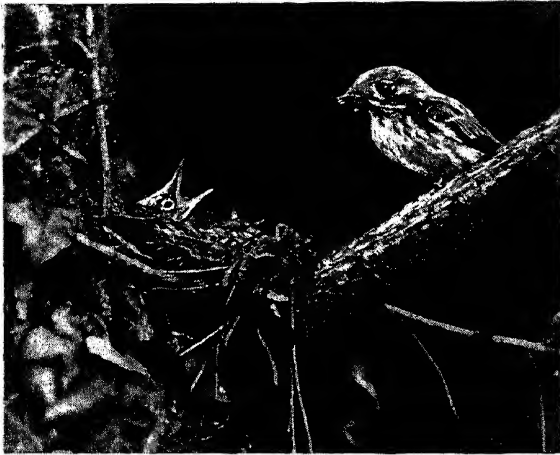
The eggs of flies differ greatly in shape and size from species to species, and are usually laid in large numbers. Many generations can be produced in one season if conditions are favorable. The eggs are usually laid in some environment that will provide the larvae with adequate food. In some species the eggs are fed with a nutritional secretion within the female until the larvae emerge. Fly larvae are legless and wormlike in appearance. Mosquito larvae and the larvae of certain other flies live in water. Other larvae live on plants, in soil, in decaying organic matter, or as parasites in the bodies of animals or other insects. The larvae of *Psilopa petrolei* inhabit petroleum pools in California.

Flies play an important role in the balance of nature. They carry pollen to plants; they destroy many injurious insects; they are eaten by fish; and they consume carcasses and decaying vegetation. On the other hand, flies also destroy crops; live as parasites under the skin of animals, causing a painful condition known as myiasis; and carry such diseases as typhoid, anthrax, dysentery, yaws, and cholera. Mosquitoes carry malaria, dengue fever, encephalitis, and filariasis. Certain tiny, blood-sucking moth flies carry sand-fly fever. Flies may carry parasites that transmit organisms found in excrement and other organic matter. The habits of some flies

FLYCATCHER

have been used by man for his own purposes. For example, gypsy moths and certain plant lice, which attack crops, are being successfully controlled by the larvae of the *Tachina* fly, which attacks them.

See separate articles on individual flies and diseases mentioned; see also ENTOMOLOGY; ENTOMOLOGY, ECONOMIC; ENTOMOLOGY, MEDICAL; INSECT. **FLYCATCHER**, common name for various passerine birds that capture insects on the wing. The true flycatchers are sparrow- or thrush-sized songbirds, some having very long tails, belonging to the family Muscicapidae, which in-



Spotted flycatcher, *Muscicapa striata* NATURE Magazine

cludes about 325 species. The birds are natives of the Old World. They are frequent visitors to northern Europe during the summer, but are never seen in the United States. These birds usually dwell in woodlands and do not travel in flocks. Most are small and extremely active. They dart quickly from their perch on a railing or exposed branch to snap up an insect, and then return to the same perch, remaining there until another insect comes into view. The broad, angular bill, slightly curved at the end, with stiff bristles pointing forward at the base, is adapted to successfully securing the prey. The legs and feet are usually small and weak. The wings are typically long and pointed. Flycatchers breed in various places, and many species construct elaborate and decorative nests.

Four or five species are common in Europe, including the spotted flycatcher, *Muscicapa striata*, and the pied flycatcher. Many of the tropical species, such as the paradise flycatcher and the fantailed flycatcher, possess crests and long tail feathers. Some of the smaller tropical species are called fly snappers.

The American flycatchers, belonging to the

family Tyrannidae, are classified into some 365 species, most of which are tropical. The feathers are usually olive green or dark gray, often ornamented with red markings on the head and wings. Commonly called tyrant birds, these birds resemble the European flycatchers in both habits and structure. American flycatchers lay from two to six eggs in a clutch and vary greatly in their nesting habits. The crested flycatcher, *Myiarchus crinitus*, often nests in the deserted hole of a woodpecker and prefers to line its nest with a cast-off snakeskin. Among the common flycatchers of the United States are the kingbird (q.v.), the phoebe, the chebec, known also as least flycatcher, and the wood pewee. See also GNATCATCHER.

FLYING. See AIRPLANE; AVIATION; FLIGHT, THEORY OF; GLIDER; HELICOPTER; JET PROPULSION.

FLYING DRAGON. See LIZARD.

FLYING DUTCHMAN, central, haunted figure of a nautical legend concerning a ghost ship, to which the name is also applied. According to the legend, the Dutch mariner, accursed for a blasphemous oath, is doomed to sail eternally about the Cape of Good Hope. His phantom vessel supposedly boded disaster for any sailors who saw it. Another version of the legend depicts the condemned captain as sailing aimlessly in the North Sea while playing dice, for his soul, with the devil. The legend is well known through its adaptation in the three-act opera *Der Fliegende Holländer*, by the German composer Richard Wagner (q.v.), which was first produced in Dresden in 1843. In Wagner's romantic version, the Dutchman must sail with his spectral crew until he is redeemed by a woman's love, and may land once every seven years to seek such love. He lands in Norway during a storm and meets Senta, who pledges her love. When the Dutchman suspects she has forsaken him for the huntsman Erik, another suitor, he weighs anchor. Senta throws herself into the sea, and both of them are borne to heaven.

FLYING FISH, fish that are able to leave the water by lashing motions of the tail and to propel themselves through the air in limited glides. Most flying fish are found in tropical and semitropical waters, although some species range farther north. Pursuit by other fish is believed to be the cause of their leaving the water; once in the air, however, they become the prey of various fish-eating birds. Their flight may consist of several hops, in which they repeatedly return to the surface of the water long enough to renew their propelling power. They rise to a maximum of about 35 ft. into the air and glide as far as 200 yd. This flying activity is often exhibited simul-

taneously by an entire shoal of flying fish. Although the tail provides the sole means of locomotion, the greatly elongated pectoral fins serve to maintain equilibrium in flight.

The true flying fish, belonging to the genus *Exocoetus* and allied genera, are included in the family Exocoetidae. The members of this genus have large, stiff pectoral fins almost as long as the body; the upper lobe of the caudal fin is smaller than the lower. The head and body scales are large and soft, and a ridge runs longitudinally along either side of the body. The most common flying fish, *E. volitans*, is found in both the Atlantic and Pacific oceans. This fish is dark brown, with a white marking on the back, behind the pectoral fins; *E. furcatus* is another common species with the same geographical range. The great flying fish, *E. californicus*, is found along the coast of California; it attains a length of 18 in., 6 to 12 in. longer than most species. *Fodiator actus*, the sharp-nosed flying fish, is found in the waters off both sides of Central America. About 100 species of flying fish exist; they are the natural prey of the bluefish and albacore. The flesh of flying fish is often used by man for food.

FLYING FOX. See BAT: Divisions.

FLYING LEMUR. See COLUGO.

FLYING SAUCER, in popular usage, name applied to any object, identifiable or not, seen moving through the sky at high speed. The name was originated in 1947 by an American businessman who, while piloting his private airplane near Mt. Rainier, Wash., avowedly observed a fleet of saucer-shaped aircraft flying silently in formation and at a prodigious speed. The United States Air Force disclaimed knowledge of such a flight, however, and denied the existence of experimental aircraft resembling the type described.

Similar sightings were reported subsequently throughout the U.S. as well as in other countries. The objects, shaped like disks, rockets, or cigars, were reportedly seen flying singly or in formation. During the day they were generally described as metallic silver. Those sighted at night were of different colors. Alleged photographs of such objects were investigated by the defense authorities of various governments.

In 1955 the U.S. Air Force released the results of an eight-year investigation of so-called flying saucers, which had been designated officially as unidentified flying objects (UFO). The air force analyzed nearly 5000 reports, most of which were traced to sightings of conventional and experimental aircraft and weather balloons or to astronomical phenomena and illusions. By the

end of 1966 the air force had studied 11,207 reports of unidentified flying objects and had explained all but 675. In most cases, inability to make identification was attributed to the ambiguity or vagueness of the reporter. Despite claims of flying-saucer supporters, the air force has found no evidence that such aircraft originate in outer space or in a foreign country.

In October, 1966, the air force assigned to the University of Colorado the task of investigating the data and reports of flying objects for which no satisfactory explanation had been established. The study was placed under the direction of Dr. Edward Uhler Condon (q.v.), former director of the National Bureau of Standards. In early 1969 the press reported that Condon and his associates had found no evidence had been established linking the unidentifiable flying objects with intelligently guided spacecraft from beyond the earth. The conclusions of the Condon report received firm support from a panel of eminent scientists convened by the National Academy of Sciences.

FLYING SQUIRREL, nocturnal rodent having on each side of the body a flap of skin which extends from the forelegs to the hind legs, and is partly supported by the bones of the feet. When the legs are extended, this fold of skin expands like a parachute, enabling the animal to take extraordinary leaps. Flying squirrels glide from higher to lower branches, sometimes covering a distance of 30 yd. They have dense, soft fur and long, flat tails. These animals live mostly on nuts, buds, and insects, storing up nuts for the cold months that are spent in hibernation. They usually spend the daylight hours in tree holes, which they line with fur and other soft materials. Some flying squirrels nest in abandoned birds' nests and others construct their own nests of twigs and leaves in the form of a globe.

Two main groups of flying squirrels are known. In one, classified in the same family as the true squirrels (see SQUIRREL), the skin fold is attached at the wrist. This group is made up of three genera: *Pteromys*, containing the Indian flying squirrel; *Eupetaurus*, moss-eating squirrels found in the Himalayas; and *Sciuropterus*, found mostly in Indo-Malaya, but also having one eastern European and one North American species. *S. sobrinus*, found in Canada, is brown except for the underparts, which are white. *S. volucella*, which ranges in the United States from the Atlantic coast to the western plains, is predominantly gray in color, and measures between 9 and 14 in. in length, including the tail. The other group of flying squirrels is found in Africa, and

FLYING TIGERS

comprises two genera, *Anomalurus* and *Idiurus*, of the family Anomaluridae. The skin fold of this group is attached at the elbow joint.

Certain marsupials, which are more properly called flying phalangiers, are also sometimes referred to as flying squirrels.

FLYING TIGERS. See CHENNAULT, CLAIRE LEE.

FLY MUSHROOM. See MUSHROOMS: *Poisonous Mushrooms*.

FLYWHEEL, in engineering, massive wheel attached to the shaft of an engine (q.v.) to ensure steady speed or rotational movement. The fly-wheel effect is produced by the property of inertia (q.v.) possessed by the wheel, which enables it to absorb and release energy (q.v.) with little variation in speed, producing an almost constant rotational motion. See INTERNAL-COMBUSTION ENGINE: *Components of Engines*; STEAM AND STEAM ENGINEERING: *Modern Steam Engines*.

FM. See FREQUENCY MODULATION.

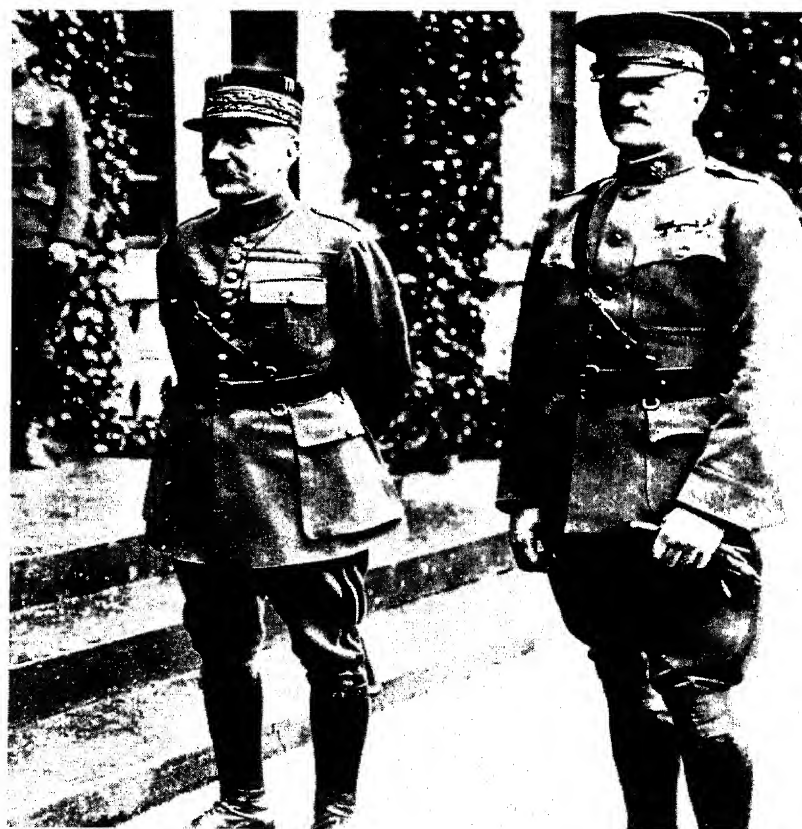
FOAM RUBBER. See RUBBER, SYNTHETIC: *Types of Synthetic Rubber*; *Other Specialty Rubbers*.

FOCH, Ferdinand (1851–1929), French army officer, born in Tarbes, and educated at a Jesuit college in Saint Étienne and at the École Polytechnique, Paris. He was commissioned in the artillery corps in 1873, and became professor of strategy at the École Supérieure de Guerre ("War College") in 1894. His lectures established him as a leading military theoretician of

his country. In 1907 Foch was appointed commandant of the War College and was made a brigadier general. During the following years he became one of the outstanding leaders of the French army.

Shortly after the outbreak of World War I, Foch was given command of the new ninth French army and fought with distinction at the first Battle of the Marne (see MARNE, BATTLE OF THE). On Oct. 4, 1914, he was made deputy to the commander in chief and charged with the coordination of the heterogeneous French, Belgian, and British forces comprising the Allied forces in northeastern France. During 1915 and the greater part of 1916, Foch was the commanding general of the Allied armies in the north. Disappointment with the indecisive outcome of the Battle of the Somme led the French government to remove from their posts a number of commanding officers, including Foch; he was given a relatively minor post. When, however, General Henri Philippe Pétain (q.v.) was made chief commander of the French armies in May, 1917, he insisted on Foch's appointment as chief of the general staff of the French army. In the same year, Foch was made president of the Inter-Allied Council, the body charged with making strategic decisions with respect to the overall conduct of the war.

The great German offensive in France in the



Marshal Ferdinand Foch (left) with General John J. Pershing, U.S. Army, near the close of World War I.

UPI

spring of 1918, which threatened the Allies with defeat, impressed on them the urgent need of appointing a supreme military commander; and in April Foch became commander in chief of all Allied armies, including the American, then fighting in France. After a number of initial setbacks, Foch launched the series of counteroffensives that led to final victory.

In 1918 Foch was made a marshal of France and was elected to the French Academy; he was also honored by Great Britain, Poland, and the United States.

FOEHN. See CHINOOK.

FOETUS. See FETUS.

FOG or MIST, cloud of condensed water vapor in the form of water droplets or ice crystals, suspended in the atmosphere just over the surface of the earth. In cities and industrial areas, fog often combines with smoke to produce the mixture called smog (q.v.). See also AIR POLLUTION.

Meteorologically, fog can be classified into four general types according to the mechanism by which it is formed. The types are advection fog, radiation fog, upslope fog, and precipitation fog.

Advection fog is formed whenever a current of relatively warm, moist air passes over a colder body of land or water. Fog of this type is frequent in the winter when snow is lying on the ground. It is also common over the ocean, as in the North Atlantic when winds blow across the warm Gulf Stream and reach the cold Labrador Current (qq.v.). In summertime, lakeside and seaside advection fogs occur with offshore winds, because the land is warmer than the water. In wintertime, the water is frequently warmer than the land, and fogs occur when air moves inshore. A type of advection fog that is common in the Arctic Regions and in temperate climates during the winter is often called arctic fog, or sea smoke. It is formed when cold air blows across comparatively warm water, and is characterized by the boiling or steaming appearance of the water surface.

Radiation fog, formed only over land, is caused by the cooling of the earth by radiation. At night, radiation lowers water temperature comparatively slowly, but land cools quite rapidly, becoming cooler than the air above it; consequently a fog is formed. Such fog is seldom thick and usually "burns off" in the morning.

Upslope fog is formed when air is evenly cooled by its rising and expanding, as when a wind flows up a mountain slope.

Precipitation fog may form during a snowstorm or rainstorm, if the snow or rain passes

through a layer of air that is cooler than the precipitation. Fog of this kind frequently occurs during the passage of warm fronts and cold fronts, when the surface air is markedly different in temperature from the upper air.

Fog and mist, like clouds, can form only in the presence of dust (q.v.) particles.

See also METEOROLOGY.

FOGAZZARO, Antonio (1842–1911), Italian novelist and poet, born in Vicenza, and educated at the University of Turin. In 1874 he published his first work, *Miranda*, a romance in blank verse. His first successful novels were *Malombra* (1881; Eng. trans., *The Woman*, 1907) and *Daniele Cortis* (1885; Eng. trans., 1887). They were the first of a series of prose works in which he enunciated the conflict between sensual desire and religious aspiration. His own devout Roman Catholicism was brought into question with the publication of *Piccolo Mondo Antico* (1896; Eng. trans., *The Patriot*, 1906), *Piccolo Mondo Moderno* (1900; Eng. trans., *The Sinner*, 1907), and *Il Santo* (1905; Eng. trans., *The Saint*, 1906). *Piccolo Mondo Antico*, which has been newly translated as *Little World of the Past* (1962), is considered his best work. In *Il Santo*, more than in his earlier works, Fogazzaro demanded reform and modernization of the Church. His demand brought him into serious conflict with Church authorities, who placed the novel on the Index of Forbidden Books (q.v.). Similarly, his last novel, *Leila* (1910; Eng. trans., 1911), was also banned by the Church.

Much of Fogazzaro's writing is autobiographical, revealing spiritual wanderings, conflicts between spiritual and mundane influences, and at least one unhappy love affair. See ITALIAN LITERATURE: *The 19th Century*.

FOGGIA, city of Italy, in Apulia Region, and capital of Foggia Province, about 80 miles N.E. of Naples. It is an important rail and road junction. Lying in the heart of the fertile Apulian plain, Foggia is the leading wheat market of s. Italy. For centuries it has been customary to store the wheat in vaults beneath the city square. The principal industries of the city are flour milling and the manufacture of macaroni, cheese, and wine. The site of the ancient city of Arpi is 3 miles N. of Foggia. The cathedral, begun in the 12th century and rebuilt after 1731, is constructed largely in the baroque style, but the foundations are Romanesque; see ROMANESQUE ART AND ARCHITECTURE. Foggia was leveled by an earthquake in 1731 and was bombed by the Allies during World War II. After the Allies took southern Italy in 1943, they built many airfields around Foggia. Pop. (1971) 141,667.



Michel Fokine (right) and his wife Vera in a 1912 performance of his ballet "Daphnis and Chloë".

Bettmann Archive

FOKINE, Michel (1880–1942), Russian dancer and choreographer, born in Saint Petersburg (now Leningrad), and trained at the Imperial Ballet School. He joined the Marinsky Theater in St. Petersburg as a soloist, but he was soon dissatisfied with the classical traditions of ballet, and attempted to introduce the freer Oriental and Greek dance forms. His earliest choreographic successes were *Les Sylphides* (1903) and *Le Cygne* ("The Dying Swan", 1905). The latter work was a solo dance that he created for the Russian ballerina Anna Pavlova (q.v.).

In 1909, in Paris, he was appointed choreographer of the Ballets Russes, a dance company formed by the Russian dance producer Sergei P. Diaghilev (q.v.). Fokine thus gained the opportunity to develop his own ideas. He achieved his greatest successes by effectively expanding the limits of traditional ballet in which music was only an accompaniment, costumes and scenery were unrelated to the subject, and dancing was almost an acrobatic exercise. Fusing music, dancing, and scenery, Fokine enlisted some of the greatest talents. His dancers included Pavlova and Vaslav Nijinsky (q.v.). Among the successes Fokine staged for the Ballets Russes were *Prince Igor* (1909), *Scheherazade* (1910), *Petrouchka* (1911), *Daphnis and*

Chloë (1912), and *Le Coq d'Or* ("The Golden Cock", 1914).

Fokine broke with Diaghilev in 1914, and thereafter his choreographic creativity declined. In 1919 he settled in New York City, and he later toured the United States and taught dancing. Fokine transformed the superficial but technically perfect traditional presentation, and restored to a primary function the male dancer, whose role had been merely to support the ballerina. See *BALLET: History: 20th Century*.

FOKKER, Anthony Herman Gerard (1890–1939), Dutch-American aircraft designer and manufacturer, born in Kediri, in the Dutch East Indies (now Indonesia), and educated in Haarlem, the Netherlands. A pioneer in the construction of airplanes, Fokker built his first factory in Germany, where he manufactured pursuit planes during World War I. After the war Fokker established factories in the United States, and he subsequently became an American citizen. He had great influence on developments in airplane construction, particularly in the use of welded-steel tubing in fuselage construction.

FOLGER SHAKESPEARE LIBRARY. See WASHINGTON, D.C.

FOLIC ACID. See *VITAMIN: Vitamin B Complex: Folacin (Folic Acid)*.

FOLK DANCING. See *DANCE: Folk Dance*; *FOLK MUSIC*.

FOLKESTONE, Great Britain, municipal borough, seaport, and resort of Kent County, England, on the Strait of Dover, about 7 miles s.w. of the city of Dover. Folkestone is an ancient town, and Roman, Saxon, and Norman ruins have been found in the immediate vicinity; the 13th-century parish Church of Saint Mary and Saint Eanswythe stands on a cliff overlooking the town. In the early 11th century the town was part of the feudal holdings of the Saxon leader Godwin, Earl of Wessex (d. 1053). It passed to Odo, Bishop of Bayeux (1036?-97), in the latter part of the century. Folkestone was associated with Dover, one of the Cinque Ports (q.v.), from an early period and in 1629 received a license to build a separate port facility.

The English physiologist William Harvey (q.v.), who discovered the circulation of blood, was born in Folkestone in 1578; his nephew founded the free grammar school there in 1674. In the 18th century, Folkestone became an important fishing and shipping center; by the middle of the 19th century it was one of the chief resort towns on the south coast. During World War I, Folkestone was an important embarkation point and training center. In 1914-15 more than 100,000 Belgian refugees passed through the port. The German bombardment of England in 1940-41, during World War II, damaged approximately 7000 dwelling units in Folkestone (see *WORLD WAR II: The European War: The Battle of Britain*). Pop. (1971 prelim.) 43,760.

FOLKLORE, general term for the traditions, customs, beliefs, oral literature, folk music, and folk dance of primitive peoples or of the uneducated classes. The term is also used to designate popular knowledge or unreflective behavior in general. It is now applied, moreover, to the study of all elements of popular culture, whether collected in the field or recorded in literary sources. The word "folklore" was coined in 1846 by the British antiquary William John Thoms (1803-85) to replace the term "popular antiquities". The German and Dutch word *Volkskunde* is slightly more inclusive, encompassing also the material features of popular culture. In the Scandinavian countries, where much progress has been made in this field, popular materials are often referred to as folk recollections (Sw. *Folkminnen*; Dan. *Folkeminder*).

Folklore Sources and Categories. The popular materials constituting folklore have been transmitted by word of mouth, by observation, and by imitation. Materials with long popular antecedents were originally little contaminated

by published sources, and such materials may still be recovered in isolated communities or under special conditions. Folklore as a creative activity and as a body of unscrutinized or unverifiable assertions and beliefs, however, has not vanished even among educated persons. The various researches of anthropologists, sociologists, psychologists, linguists, and literary scholars have modified considerably the former tendency to look upon folk literature and folk customs either as quaint and romantic or as inferior. Folklore has come to be regarded as an important source of information about the history of the human race as well as a valuable tool by which to study primitive societies.

Folklore materials may be roughly classified into five general areas: ideas and beliefs, traditions, narratives, folk sayings, and the folk arts. Folk beliefs include ideas about the whole range of human concerns, among these the reasons and cures for diseases (see *MEDICINE: Primitive Medicine*) and speculation concerning life after death (see *ESCHATOLOGY*; *SPIRITUALISM*). The same category also includes superstition, magic, divination, witchcraft, apparitions such as the ghost, and fantastic creatures from lower mythology (qq.v.). In the second classification, that of traditions, is placed material dealing with festival customs, games, and dances; see *DANCE*; *FESTIVALS AND FEASTS*; *GAMES, ANCIENT*. The third category, narratives, includes the ballad, the legend (qq.v.), the exemplum, and the merry tale, all of which may be based in part on real characters or historical events. The narrative may also take the form of a fairy tale (see *FAIRY*), folk song (see *FOLK MUSIC*), or allegory such as the fable (qq.v.). Myths, including those involving gods and heroes and those relating to the creation and destruction of the world and to great events, are also considered narratives. The category of folk sayings includes proverbs, nursery rhymes, verbal charms, and riddles. Folk arts, the fifth and only nonverbal category, covers any form of anonymous art by a particular people expressing their community life.

American folklore comprises two main divisions: the folklore of the American Indian and the Negro American and the folklore brought to America or created there by the ethnic groups that make up the population of the United States; see *FOLKTALES*; *NEGRO-AMERICAN FOLKLORE*. **Early Folklore Studies.** The formal study of folklore began about 300 years ago. One of the earliest books to take up the subject, *Miscellanies* (1696), by the English antiquary John Aubrey (q.v.), dealt with popular beliefs and customs regarding such things as omens, dreams,

second sight, and ghosts. Another early work was *Traité des superstitions* ("Treatise on Superstitions", 1679), by the French satirist Jean Baptiste Thiers (1636–1703).

The first important work on the general subject of folklore was *Antiquitates Vulgares; or, The Antiquities of the Common People* (1725), by the British clergyman and antiquary Henry Bourne (1696–1733), which was largely an account of popular customs in connection with religious festivals. *Reliques of Ancient English Poetry* (1765), edited by the British bishop, poet, and antiquary Thomas Percy (q.v.), was an important collection of English and Scottish ballads. In 1777 the British clergyman and antiquary John Brand (1744–1806) published *Observations on the Popular Antiquities of Great Britain*, which became the standard British work on folklore.

In Germany, the philosopher Johann Gottfried von Herder (q.v.) and the philologists Jacob Grimm and Wilhelm Grimm (see under GRIMM) did pioneer work in folklore. Herder published a valuable collection of German folk songs in 1778; the Grimm brothers made the collection of folktales *Kinder- und Hausmärchen* ("Childhood and Household Stories", 1812–15); and Jacob Grimm compiled *Deutsche Rechtsaltertümer* (1828) and *Deutsche Mythologie* (1835; Eng. trans. *Teutonic Mythology*, 4 vol., 1882–88).

Modern Folklore Scholarship. The study of folklore increasingly occupied the attention of scholars in Europe during the 19th and early 20th centuries. Among those who investigated and collected folklore material, formed societies, and wrote on the subject were such scholars as Paul Sébillot (1843–1914), whose collection of French folklore, *Le Folklore de France* (4 vol., 1904–07), became a standard work, and Arnold van Gennep (1873–1957), author of *La Formation des Légendes* ("The Origin of Legends", 1910) and of the monumental but unfinished work on the classification of French folklore, *Manuel de Folklore Français Contemporaine* ("Manual of Contemporary French Folklore", 4 vol. in 9 parts, 1937–58). The Spanish novelist Cecilia Francisca Josefa Böhl von Faber, under the pen name Fernán Caballero (q.v.), made an important collection of tales and songs, *Cuentos y Poesías Populares Andaluces* ("Popular Andalusian Short Stories and Poems", 1859–77); and significant work was done by the Italian editor and poet Count Angelo de Gubernatis (1840–1913), who made contributions to mythology, and by the Italian folklorist Giuseppe Pitre (1841–1916), who founded (1883)

the journal *Archivio per lo Studio delle Tradizioni Popolari* ("Archive for the Study of the Popular Heritage").

Among the important figures in later German folklore study were Adalbert Kuhn (1812–81), a founder of the science of comparative mythology; the mythologists Wilhelm Mannhardt (1831–80) and Wilhelm Schwartz (1821–99); the comparative philologist Friedrich Max Müller (1823–1900), who made significant contributions to comparative mythology; the scholar in comparative folktale study Reinhold Köhler (1830–92); the philologist Karl Weinhold (1823–1901); the folklorist Johannes Bolte (1858–1937); and the eminent folk-song and ballad scholar John Meier (1864–1953). Greatest of the Swiss folklorists was Eduard von Hoffmann Krayer (1864–1936), who compiled indispensable bibliographies and dictionaries of folklore.

The research of the German comparative philologist Theodor Benfey (1809–81) formed the basis for all later comparative work in the field. His views were espoused by Reinhold Köhler, who, studying the Sanskrit collection of fables and tales *Panchatantra* (q.v.), developed the theory that European folktales were disseminated from India; see SANSKRIT LITERATURE. In England, such works as *Researches into the Early History of Mankind* (1865) and *Primitive Culture* (1871), by the anthropologist Sir Edward Burnett Tylor (1832–1917); *Custom and Myth* (1884) and *Myth, Literature and Religion* (2 vol., 1887), by the Scottish classicist and folklorist Andrew Lang (q.v.); and in particular *The Golden Bough* (12 vol., 1907–15), by the British anthropologist Sir James George Frazer (q.v.), were landmarks of the so-called anthropological school of folklore study.

In Scandinavia, as early as the 16th century, members of the Danish nobility collected and adapted popular ballads, many of which were printed in *It hundrede vduaalde Danske Viser* ("One Hundred Selected Danish Songs", 1591) by the Danish humanist and scholar Anders Sørensen Vedel (1542–1616). The ballad treasures of Denmark, easily the richest in Europe, were edited under the title *Danmarks gamle Folkeviser* ("Denmark's Old Ballads"), beginning in 1853, by Svend Grundtvig (1824–83), and completed by other scholars forty years after Grundtvig's death. After 1867, Evald Tang Kristensen (1843–1929) made extensive collections of folklore materials from western Jutland. The Danish Folklore Archives used the Edison phonograph after 1905 to record songs from Denmark, Greenland, and the Faerøe Islands. Other Scandinavian scholars prominent in the field of

folklore include the Danish clergyman and lexicographer of folk speech Henning Frederik Feilberg (1831–1921); the Danish philologist, literary historian, folklorist, and Norse mythologist Axel Olrik (1864–1917); the Swedish folktale scholar Carl Wilhelm von Sydow (1878–1952); and the Finnish folklorists Antti Aarne (1867–1925) and Kaarle Krohn (1863–1934), who helped to develop procedures for ascertaining the component elements, place of origin, and approximate date of popular narratives. Aarne created in 1910 an important system of folktale indexing, later translated and enlarged by the American folklorist Stith Thompson (1885–1976), in *The Types of the Folk Tale* (1928).

Significant American works on folklore include *English and Scottish Popular Ballads* (5 vol., 1882–98) by Francis James Child (1825–96); *The Science of Folklore* (1930) by Alexander Haggerty Krappe (1894–1947); *Celtic Myth and Arthurian Romance* (1927) by Roger Sherman Loomis (1887–1966); *The Proverb* (1931) and *English Riddles from Oral Tradition* (1951) by Archer Taylor (1890–); *The Mind of Primitive Man* (1911) by Franz Boas (q.v.); and by Stith Thompson, *Motif-Index of Folk-Literature* (6 vol., 1932–37; enlarged edition, 1955–58), perhaps the most important work in the field. A popular comprehensive work is *Funk & Wagnalls Standard Dictionary of Folklore, Mythology and Legend* (revised 1972).

Folklore Societies. Folklore societies in Europe and the U.S. have fostered such important work as the amassing and classifying of extensive archives of folklore materials. These scholarly societies, which have helped to make the study of folklore a valuable auxiliary in anthropological and ethnological research, include the English Folklore Society, founded in 1878; the French Société des Traditions Populaires (“Society for Folk Traditions”), which in 1886 began the publication of the journal *Revue des Traditions Populaires*; and the American Folklore Society, founded in 1888, which through its publication *Journal of American Folklore* and through investigations, studies, and publications by its branch groups has extensively promoted general knowledge of, and interest in, all aspects of American folklore.

Also of great importance is the international organization Folklore Fellows, which was founded in 1907 with the help of such scholars as Axel Olrik, Carl Wilhelm von Sydow, and Kaarle Krohn, with headquarters in Helsinki, Finland. Through a series of publications, *Folklore Fellows Communications*, the organization has brought out more than 200 separate titles,

including almost forty indexes and binding lists. The International Society for Folk-Narrative Research, founded in 1959, has helped advance internationally the study of comparative folklore.

In the U.S. after 1935, scholarly and popular interest in folklore increased greatly. Many State and regional folklore societies were founded, and folklore was established as an academic discipline at leading American colleges and universities. The most important study centers are at the universities of Pennsylvania, Indiana, California (Los Angeles), and Texas, but in many other parts of the country folklore investigations, covering such matters as Negro lore and American Indian folklore, are reflected in the establishment of archives, museums, libraries, and musical collections.

The critical examination of folklore can reveal the elements common to widely varying cultures throughout the world. W.D.H.

FOLK MUSIC, type of music created as the spontaneous expression of a people and often forming part of a national or group heritage. Although folk music usually occurs among adults in rural areas, it also is found in cities and among children, whose private songs often escape the notice of adults. Usually developed by anonymous groups and individuals who have little formal musical knowledge, folk music is distinguished from art music and popular music, both of which are written by and attributed to specific composers. *See also* MUSIC.

Folk musicians usually practice music as an avocation, but many are professional musicians, earning a portion of their incomes by playing and singing. In many parts of the world, their services are required for religious and secular ceremonies such as marriages, funerals, and festivals. During the 1960's music derived from various types of traditional folk expression became especially important in the popular music (q.v.) of Great Britain and the United States. Later the lines of demarcation between folk music and such popular music forms as rock 'n' roll, country and Western, and rhythm and blues were blurred even further. Many vastly popular performers, both individuals and groups, continued to draw inspiration from traditional folk-music forms.

NATIONAL AND GROUP TYPES

The ancient Egyptians, Hebrews, and Greeks had folk music, but it has not survived. Folk songs also existed among the Germanic tribes of the 1st century A.D. European folk music began to develop significantly after the fall of the Roman Empire when the various barbaric tribes



Folk music often develops as an accompaniment for traditional dances. The music must be lively for the tarantella of southern Italy, a frenetic dance believed to have originated in a dancing mania of late medieval Europe that was attributed to the bite of a tarantula.

Bettmann Archive

that had invaded the empire settled down and formed the foundations of future nations. During late medieval and early modern times, this folk music became differentiated among various nations and groups.

The Gypsies. The gypsies (q.v.), a nomadic people, entered Europe about the 14th century and assumed the social and musical role previously occupied by itinerant European minstrels. The gypsies transformed the music of the areas through which they wandered, turning simple melodies into highly ornamented ones. Gypsy instrumentalists, renowned since the 18th century for their skill on the violin and Spanish guitar, continue to perform, especially in Spain. In the 19th century, scholars began to study gypsy music in the Balkans, Hungary, and Spain.

The Balkans. Folk music on the Balkan Peninsula (q.v.) is most easily recognized by its compound meters in which each measure is made up of groups of beats, such as 3 + 4 or 3 + 2 + 2 + 2. Many Balkan songs are used to accompany round dances performed by a circle of dancers. The musical styles of the various Balkan countries differ considerably. Greek music is always performed in unison, while in parts of Yu-

goslavia, Bulgaria, and Albania two or more simultaneously sounding parts are favored, often resulting in polyphony (q.v.).

Hungary and Eastern Europe. The songs and dances of the gypsies were long considered the typical music of Hungary. In the 20th century, however, the Hungarian composers Béla Bartók and Zoltán Kodály (qq.v.) discovered an enormous amount of ancient Hungarian peasant music. Many Hungarian songs have an irregular rhythmic structure, with tunes often founded on a five-tone, or pentatonic scale; see SCALE. Laments are highly ornamented and rhythmically free. Similar features, as well as polyphonic singing, occur in the music of Slovakia. In other Slavic and Slavic-influenced areas the choral polyphony uses very old scale patterns and shifts frequently from one meter to another. Such Russian composers as Modest Petrovich Musorgski and Igor Fëdorovich Stravinsky (qq.v.) have used folk polyphony, especially in the former's opera *Boris Godunov* (1874) and in the latter's ballets *Petrouchka* (1911) and *Les Noces* (1917).

Spain. Some genres of Spanish folk music are related to ancient Muslim music; see ARABIC MUSIC. Numerous epic songs exist in Catalonia, but the most famous and popular form is a ring dance known as the *sardana*, which is performed every day in the plazas of Catalonian towns. Although the songs and dances of Andalusia vary according to locality, the *sevillana* (in Seville), the *malagueña* (in Malaga), and the *granadina* (in Grenada) all seem to be related to the *fandango* dance. The *flamenco*, an intense and highly rhythmical combination of singing, dancing, and playing practiced by the gypsies of Andalusia, has become famous throughout the world.

Italy. The music of Italy ranges from the simple songlike verse structures of the north to the quasi-oriental styles of southern Italy, Sardinia, and Sicily. The polyphonic singing of the north often resembles the music of the Renaissance; see MUSIC: *The Renaissance*. The *stornello*, a solo song with improvised verses, and the *saltarello*, a lively dance, are popular in central Italy. In the south the most popular dance is the *tarantella* (q.v.), once thought to be the only cure for the bite of the tarantula. The bagpipe is played in central and southern Italy, and the folk musicians of Sardinia use the *launeddas*, a triple-reed pipe similar to the ancient clarinet of Egypt. In Sicily, where many medieval tales are preserved among the people, it is still possible to hear epic songs dealing with such heroes as Roland (q.v.).



The playing of the Hardanger fiddle (figure at left), an eight-stringed violin, is a popular Norwegian pastime.
Norwegian National Travel Office

Germany. In Germany the folk song of Volkslied attained its highest development in the period between the 14th and 17th centuries. The *Volkslied* is characterized by vigor, simplicity, directness, and sentimentality. The German religious reformer, Martin Luther (q.v.), fitted religious texts to familiar German folk tunes. The German folk song also had a great influence on the art music of Germany; nearly all important German composers have used folk songs as themes in their compositions.

Bohemia. The folk music of Bohemia, like that of Germany, has a regular rhythmic pulse, tonal harmonies, strophic repetition patterns, and melodies that emphasize the tones of major or minor chords. At one time the bagpipe (called in German the *Dudelsack*) was extremely popular in Germany, and it remains so in Bohemia, Poland, and Hungary.

France. Although the French folk song varies from one region to another, it is usually performed by a soloist. Polyphonic music occurs among the people known as the Basques (q.v.) and, in a different form, in the playing of the *musette* (Fr., "bagpipe"), which was imitated frequently in the *Musette* movements of suites written in the Baroque era; see SUITE. Similarly, such old French folk dances as the *bourrée*, the *gavotte*, and the *sarabande* became popular among the French aristocrats of the 17th and 18th centuries. These dances, in highly stylized

forms, were incorporated in the suites of many Baroque composers.

Great Britain. The best-known type of British folk song in the English language is the ballad (q.v.), which is also encountered in Germany, the Netherlands, Scandinavia, the Baltic area, and America. Most ballads tell a story, and in English folk music about 300 basic stories exist, each with an enormous number of textual variants. The tunes of these ballads differ widely from one area to another, and the same story may be sung to many different tunes.

The music of the Celtic-speaking inhabitants of Scotland and Wales differs from English folk music, although many Gaelic versions of English ballads exist; see CELTIC PEOPLES AND LANGUAGES; GAELIC LANGUAGE. Much of the traditional music of the Highlands and islands of Scotland accompanied work, including the *waulking* songs sung by women shrinking tweed, rowing songs, and reaping songs, many of which continue to be sung purely for pleasure. Highland bagpipe music remains popular, even in the exacting classical form known as *pibroch*, with its many and lengthy variations on a ground. Much Scottish music, whether in Scots or Gaelic, uses a pentatonic scale. Another feature found all over Scotland is the so-called Scotch snap, which

FOLK MUSIC

consists of a pair of notes, the first very short and the second longer.

Ireland. Although ballads, political and satirical songs, and traditional fiddling are much admired in Ireland, the most popular folk music is that performed by the *ceilidhe* bands, usually consisting of flutes, accordions, and fiddles. The outstanding characteristic of the Irish folk song is the poetic beauty of its melody, often sung by a fine tenor voice.

Scandinavia. In the Scandinavian countries, a widely prevalent type of song is the strophic epic known in Iceland as the *rimur* and elsewhere by a variety of other names. Consisting of tales of old heroes, the *rimur* was formerly sung by one member of a farm family on cold dark nights while the rest of the group sat in semi-darkness. Old European ballad round dances are frequently performed in the Faerøe Islands, where the people sing tales while dancing slowly in a circle. An especially interesting Norwegian genre is performed on the Hardanger fiddle, an elaborately decorated violin with a high belly and five extra, sympathetically sounding strings under the bridge. Hardanger fiddle

music is extremely complex rhythmically. This music is also polyphonic, and much of it is designed for the characteristic Norwegian dances, the *springar*, the *halling*, and the *gangar*. The Norwegian composer Edvard Hagerup Grieg (q.v.) was strongly influenced by this music.

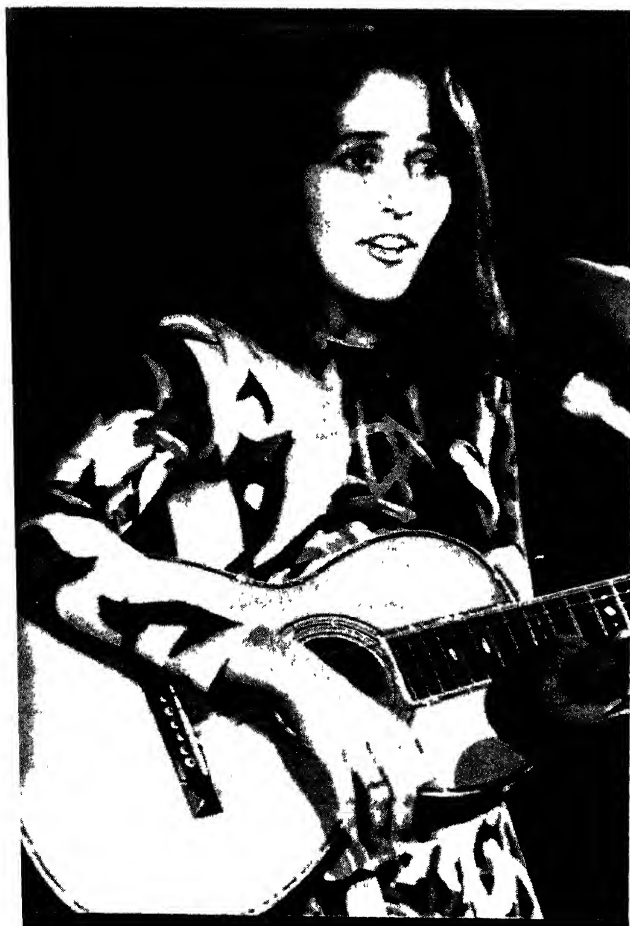
North America. The folk music of the U.S. and Canada is derived largely from the folk music of Europe and Africa. In isolated communities the music may remain just as it had been in the old country. Among the remote districts of the Appalachian mountains, for example, folk musicians sing ballad tunes that are no longer known in England. The songs of Gaelic Scotland continue to be sung in Nova Scotia, and the people of the Georgian Bay islands preserve much of the west African heritage in their singing style. Many old French folk songs are preserved among the French-speaking inhabitants of Québec, Canada, and to a lesser extent, in Louisiana.

A number of new types of folk song arose among the settlers of North America. One type was the immigrant song, in which the new arrival sang of his homesickness and of the hardships of his new life. Another musically productive tradition was the *voyageur* (Fr., "traveler") song of the Canadian fur traders, who traveled by canoe through the Great Lakes. In the southern States of the U.S., workers in the field carried on the ancient call-and-response patterns of African music (q.v.; see also JAZZ). Convicts, roustabouts, and railway construction gangs sang in such patterns while they worked, developing songs like "John Gilbert is de Boat," "Go Down," and "Old Hannah". Cowboys sang such songs as "The Lone Prairie".

Latin America. The folk music of Latin America is derived from three major sources: indigenous Indians, the natives of west Africa brought to the region as slaves, and the Spanish and Portuguese settlers. The best-known style of Indian music is found in the former Inca territories (Bolivia, Ecuador, and Peru). This music is characterized by the use of the pan-pipes and the pentatonic scale. In Mexico, Indian music of apparently pre-Columbian origin survives. See AMERICAN INDIANS: *Indians of South America*. African-derived music, with its complex rhythms and call-and-response patterns, occurs in the Brazilian province of Bahia, Surinam, coastal Venezuela and Colombia, and the islands of the Caribbean. The Spanish *villancico*, or carol, is sung from Argentina to Puerto Rico. Dances include the Argentine tango and the Brazilian samba.

T.C.G.

Folk singer Joan Baez has interpreted many American semitraditional songs and ballads. UPI



FOLKTALES or FOLK STORIES, tales or stories originating in remote times and handed down orally from generation to generation by the common people of a race or nation. The principal types are the fairy tale (see FAIRY), fable, legend (qq.v.); and myth (see MYTHOLOGY). A fairy tale is characterized by a narrative that is improbable in content, or in which the supernatural abounds, and by a hero or heroine whose character, rather than undergoing dramatic development, remains static within the framework of the plot. A fable is a story about animals endowed with human speech and is designed to illustrate a moral. A legend involves real persons and events, and is thus usually set in a specific time and place. Myths relate incidents about gods and often attempt to explain the creation of the world and the phenomena of nature.

History. Many European folktales have been recorded directly from the oral tradition by students of folklore (q.v.), most of whom lived after 1700. Other tales have been preserved in literature, either in elaborated form as the basis of poems and fiction, or as fragmentary literary themes. The oldest folktale still traceable is the Egyptian story of Anfu and Bitiu, dating from the 13th century B.C.

In both ancient and modern times, the folktale has served as raw material for sophisticated literary works as diverse as the Greek epic the *Odyssey* (q.v.), the Hindu sacred book the *Rig-Veda* (see VEDA), and ribald stories found in the 14th-century *The Decameron* (q.v.) by the Italian writer Giovanni Boccaccio (q.v.). Among the other notable literary works of which folktales form a part are the Sanskrit book of fables the *Panchatantra* (q.v.); the collection of tales and romances *Katha-sarit-sagara* ("Ocean of Streams of Story") by the Indian Sanskrit writer Somadeva (fl. 11th cent.); the collection of Arabian tales the *Thousand and One Nights* (see ARABIAN NIGHTS); the medieval collection of Latin stories concerning the deeds of the ancient Romans, *Gesta Romanorum*; the French fabliaux (see FABLIAU); and the 16th-century tales *Tredici Piacevoli Notti* ("Thirteen Facetious Nights") by the Italian writer Giovanni Francesco Straparola (q.v.).

European Contributions. The earliest notable collection of the type called the fairy tale was the *Pentameron* of Giambattista Basile (1575?–1632). Of the fifty tales in this collection, all but ten found later analogues in the great collection of the German philologists Jacob Ludwig Karl Grimm and Wilhelm Karl Grimm (see under GRIMM). The *Contes de Ma Mère l'Oie* ("Tales of Mother Goose", 1697) by the French writer



Sinbad carried off by the roc, an illustration for the Thousand and One Nights.

Charles Perrault (q.v.), which included such well-known stories as "Cinderella", "Little Red Riding Hood", and "Sleeping Beauty", came closer to the folk idiom than did the florid work of Basile. Perrault's book created a vogue for fairy tales, and many such tales were written in Europe, particularly in France; among these were the *Contes Nouveaux* ("New Tales", 1698) by the French author Marie Catherine Jumel de Berneville, Comtesse d'Aulnoy (1650?–1705).

In the early 19th century great interest was created in fairy tales and other types of folktales by the publication of the first edition of *Kinder- und Hausmärchen* ("Childhood and Household Stories", 1812–15), by the Grimm brothers. This work consisted of German folktales, especially fairy tales, which the brothers had collected from the common people of Germany and also from books and manuscripts. It stimulated writers of many other nations, including the Scottish classicist and folklorist Andrew Lang and the Danish author Hans Christian Andersen (qq.v.), as well as others mentioned below, to make similar collections from the traditional tales of their own peoples. The Grimm brothers found great similarity between German folktales and those of other European nations; later folklorists discovered a resemblance between European folktales and those of other continents.



Paul Bunyan, lumberjack hero of the American tall tale, from a drawing by the American illustrator Rockwell Kent. Harcourt, Brace and World, Inc.

Oriental Influence. Three principal theories have been advanced to account for these similarities. According to the Grimm brothers and their followers, the folktales common to European peoples once formed part of the mythology of the Indo-European peoples and were carried westward during their migrations from their original home in the regions between the Caspian and the North seas. A second theory was that which the German Sanskrit scholar Theodor Benfey (1809–81) advanced in the introduction to his translation (1859) of the *Panchatantra*. According to Benfey, most European folktales originated in India and were carried westward by such peoples as the Moors, Jews, and Gypsies, who made their way into southern Europe, and the Mongols, who penetrated eastern Europe. In addition, Benfey pointed out, Europeans who visited the East often returned with these tales, variants of which found their way into the contemporary folklore of the various European cultures. A third attempt to account for folktale similarities is the anthropolog-

ical theory of the British scholar Sir James George Frazer (q.v.) and others. The advocates of this theory contended that, given similar physical conditions in different regions and also similar levels of culture, folktales containing similar ideas, incidents, and narrative arrangement are bound to be created on the basis of psychic unity; that is, out of normal human and historical conditions. Modern scholars do not wholly accept any one of these theories as an adequate explanation of all, or even most, of the similarities that exist among different folk stories. It now seems evident that so many sources and influences have affected the development of the European folk tradition that, except in rare cases, the exact history of any given story cannot be clearly traced.

Modern Collections and Scholarship. Among the numerous folktales gathered and published since the 18th century have been folktales from every country or region of Europe. In the 20th century, registers of hundreds of thousands of folktales found throughout Europe were com-

piled into an elaborate system, in an attempt to discover and compare the basic types. All of the tales recorded in the registers are considered to belong to 540 distinct types summarized in the basic reference work *The Types of the Folk Tale*, which was compiled by the Finnish folklorist Antti Aarne (1867–1925) in 1910 and translated and enlarged by the American folklorist Stith Thompson (1885–1976) in 1928 and 1961. A six-volume companion study of Thompson's, *Motif-Index of Folk-Literature*, was published in 1932–37 and in an expanded edition in 1955–58. This index provides a basis for comparison of different tales through the examination of universal folk motifs. The two works by Thompson are useful adjuncts to the five-volume set of notes to the Grimm tales.

Tales have been gathered also from many other peoples, including American Indians, the Annamese (in central Vietnam), Brazilian Indians, Eskimo, and Hottentots (in South Africa).

American Folktales. Among well-known American folktales are those based on Negro-American folklore, which to a great extent make up the book *Uncle Remus: His Songs and His Sayings* (1880) by the American writer Joel Chandler Harris (q.v.; see NEGRO-AMERICAN FOLKLORE). Many European folktales were transplanted to the American continent and preserved in the French tradition of the Saint Lawrence and Mississippi river basins and in the Spanish tradition of California, New Mexico, and other southwestern States. A smaller number of European tales, notably the so-called Jack tales, collected after 1925, has been preserved in the English-speaking tradition of the Appalachian Mts. Some of these stories are related to the European narrative cycle known as "Jack the Giant Killer". Another large class of American folktales consists of stories concerning American pioneers, frontiersmen, and workers in various occupations, stories that were first created orally and later printed in almanacs, newspapers, and books. These folktales make use of the anecdote, legend, ballad, and, particularly, a type of story known as the tall tale, which is characterized by boastful narration and by extravagant deeds of the central character. Much of the humor in these tales is the result of the incongruity between the realistic manner of the narrative portrayals and the fantastic or comic events of the stories themselves. The tall tale and other forms of the American frontier folktale have led to the creation of a number of folk heroes, whose deeds and personal characteristics led to their assimilation into popular American culture. These American folk heroes include

the legendary woods-craftsman Johnny Appleseed; the giant lumberjacks Paul Bunyan (qq.v.) and Tony Beaver; the keelboatman Mike Fink; and the railroad engineer Casey Jones. Other folk heroes, who have arisen from exaggerated biographies of actual men, include the pioneers and frontiersmen Daniel Boone, James Bridger, Christopher (Kit) Carson, and David (Davy) Crockett; the desperado Billy the Kid; and the bank and railroad robber Jesse James (qq.v.). Tall stories also exist concerning animals, and include tales of Pacing Mustang, a legendary wild stallion of the western frontier; the Big Bear of Arkansas, a legendary animal who for years evaded all efforts to kill him; and a frog, noted for its ability to win jumping contests from other frogs and the hero of the old California folktale forming the basis for the story *The Celebrated Jumping Frog of Calaveras County* (1865) by Mark Twain (see CLEMENS, SAMUEL L.).

W.D.H.

FONDA, Henry (Jaynes) (1905–), American stage and motion-picture actor, born in Grand Island, Nebr. Fonda briefly attended the University of Minnesota, and then appeared in several stage productions, the first of which was *You and I* (1925), in Omaha, Nebr. His first motion-picture role was in *The Farmer Takes a Wife* (1935). Two of his most highly acclaimed film

Henry Fonda in one of his most memorable motion-picture roles, that of Tom Joad in the 1940 classic The Grapes of Wrath.

UPI



FOND DU LAC

roles were the title role in *Young Mr. Lincoln* (1939) and the role of Tom Joad, a refugee from the Oklahoma dustbowl, in *The Grapes of Wrath* (1940). In later years, Fonda divided his time between films and the stage. He created the title role in the Broadway play *Mister Roberts* (1949) and played the same role in the film adaptation (1955). He appeared in a 1972 Broadway revival of *The Time of Your Life*; and his most recent film was *Sometimes a Great Notion* (1972). His children, Jane (1937–) and Peter (1939–), have also pursued motion-picture careers. Jane starred in, among others, *Klute* (1971), for which she won the best-actress award in 1972 from the Academy of Motion Picture Arts and Sciences. Peter wrote, produced, and acted in *Easy Rider* (1969) and starred in *Two People* (1973).

FOND DU LAC, city in Wisconsin, county seat of Fond du Lac Co., at the s. end of Lake Winnebago, about 60 miles n.w. of Milwaukee. Fond du Lac, in a farming and dairying region, is the commercial center for the many vacation resorts on the lake. The principal industries in the city include the processing of dairy products and the manufacture of machinery and tools, wooden and leather goods, refrigerators, outboard motors, automobile parts, and playground equipment. The city has facilities for boating, bathing, and fishing. A Capuchin monastery and college, founded in 1870, are situated a few miles e. of the city. Fond du Lac, for many years the site of a French trading post, was settled permanently about 1835. It became a city in 1852. Pop. (1960) 32,719; (1970) 35,515.

FONSECA, Manuel Deodoro da (1827–92), Brazilian general and statesman, born at Alagoas and educated for a military career. In 1864–70, he served as a major general in the war with Paraguay; see BRAZIL: *History*; PARAGUAY: *History*; URUGUAY: *History*. The war brought an upsurge of political activity by army officers; they found a champion in Fonseca who, despite his conservatism and personal attachment to Pedro II (q.v.), Emperor of Brazil, protested the emperor's arbitrary actions. Punished for insubordination, Fonseca led a bloodless revolution, forcing the emperor's banishment and the creation of a republic on Nov. 15, 1889. Fonseca served as provisional president until February, 1891, when he was elected by the assembly. Inexperienced in democratic administration in a country lacking a tradition of political equality, he came into conflict with the congress, which he dissolved in favor of a personal dictatorship. Faced by dissidence in the army and revolt in the navy, he resigned in November. Fonseca's brief term was

nevertheless notable. The republic was recognized abroad and by the United States; a new constitution granting autonomy to the states was adopted; and separation of church and state was achieved.

FONSECA, GULF OF, sheltered inlet on the Pacific Ocean, bounded on the n. by El Salvador, on the e. by Honduras, and on the s. by Nicaragua. One of the finest natural harbors in the world, it covers 750 sq.mi. The most important ports on the gulf are La Unión, El Salvador; Amapala, Honduras; and Puerto Morazán, Nicaragua. A 1916 treaty granted the United States a perpetual option to construct an interoceanic canal and naval base in the area. The Spanish conquistador Gil González Dávila (1470?–1528?), discovered the gulf while seeking a waterway from the Atlantic to the Pacific oceans.

FONT (Lat. *fons*, "spring", "fountain"), in Christian ecclesiastical usage, receptacle containing the water used in baptism (q.v.). The font consists of a basin, usually of stone but sometimes of wood or metal, mounted on one or more pillars.

In the early Church, baptism was effected by immersing the candidate in the waters of a natural source, such as a spring or river. Later, a separate building known as a baptistery (q.v.), enclosing a large tank used for immersions, was erected near the church. These early methods of baptism eventually were replaced in most denominations by baptism by infusion, or pouring, which involved the use of fonts. The term is also applied to the vessel, placed at the entrance to a Catholic church, that contains the holy water (q.v.) provided for persons entering and leaving the church.

FONTAINE, Jean de la. See LA FONTAINE, JEAN DE.
FONTAINE, Joan (1917–), American stage and motion-picture actress, born Joan de Beauvoir de Havilland in Tokyo, Japan. She and her sister, the actress Olivia de Havilland (q.v.), were born of British parents and grew up in Saratoga, Calif. Joan Fontaine made her motion-picture debut in *No More Ladies* (1935). Two years later she adopted the surname of her stepfather, George M. Fontaine. Miss Fontaine's first major role in films was in *Rebecca* (1940). Other notable film appearances by Miss Fontaine were in *Suspicion* (1941), for which she won the best-actress award of the Academy of Motion Picture Arts and Sciences, *The Constant Nymph* (1943), *Jane Eyre* (1944), *Letter From an Unknown Woman* (1948), *Until They Sail* (1957), *Tender Is the Night* (1962), and *The Devil's Own* (1967). She made her New York City theatrical debut in 1954 in *Tea and Sympathy*, by the American

playwright Robert Anderson (1917–). She was naturalized a United States citizen in 1943.

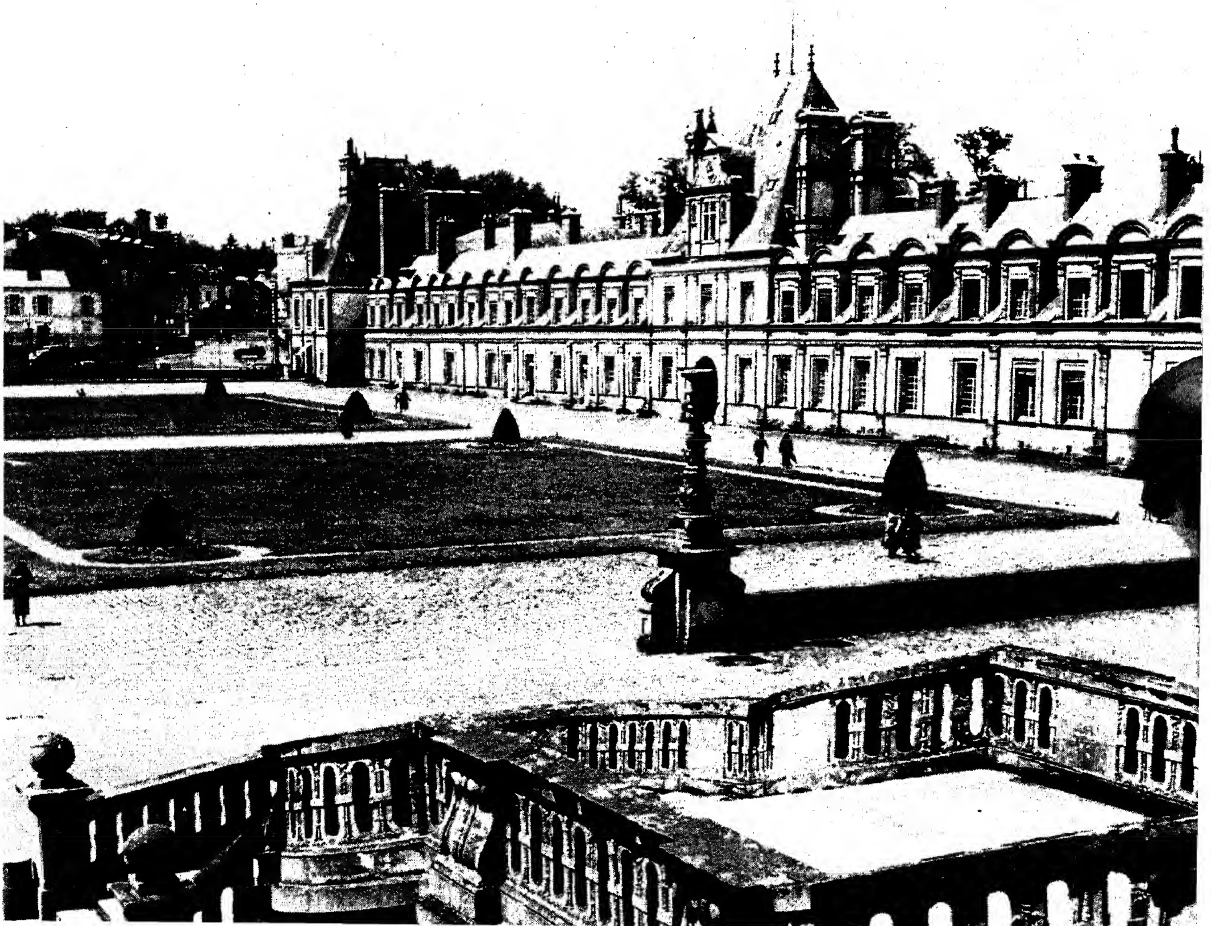
FONTAINEBLEAU, town of France, in Seine-et-Marne Department, near the Seine R., about 37 miles S.E. of Paris. The town lies in the famous Fontainebleau Forest, which covers an area of more than 42,000 acres. Fontainebleau is noted chiefly for its fine Renaissance château, at one time a residence for the kings of France. The château is surrounded by landscaped grounds and formal gardens comprising an area of 200 acres. In the early 16th century, King Francis I (q.v.) assembled there a large number of artists, known as the School of Fontainebleau, to decorate the château. Various other French monarchs, notably Henry IV, Louis XIII, Napoleon I, Louis XVIII, Louis Philippe, and Napoleon III (qq.v.), spent billions of francs in further beautifying it. The château was the residence of Christina, Queen of Sweden (1626–89), after her abdication in 1654. Among the many important state documents that were drawn up at Fontainebleau are the revocation in 1685 of the Edict of Nantes (q.v.) and the decrees of abdication signed by Napoleon I in 1814 and in 1815. The château is maintained as a public museum by the government. Pop. (1970 est.) 19,803.

FONTANA, city of California, in San Bernardino Co., about 8 miles W. of San Bernardino. Fontana has one of the largest integrated steel mills on the west coast. The city is located in an area of citrus groves and vineyards, and poultry and rabbits are raised. Settled in 1905, Fontana was incorporated in 1952. Pop. (1960) 14,659; (1970) 20,673.

FONTANA, Domenico (1543–1607), Italian architect and engineer, born in Mili, near Lake Como. While studying architecture in Rome he became the protégé of Cardinal Felice Peretti, later Pope Sixtus V (see *under* SIXTUS). For the cardinal he planned and supervised the building of the Villa Negroni and of a chapel in the Church of Santa Maria Maggiore, both in Rome. Upon the election of his patron to the papacy in 1585, Domenico was made papal architect, an appointment he retained until after the death of the pope. He designed the palace of Monte Cavallo, the Vatican library (see VATICAN, PALACE OF THE), and the Lateran (q.v.) Palace, and engineered the transfer of an Egyptian obelisk to a position in front of Saint Peter's Basilica (q.v.). With his countryman the architect Giacomo

The château of Fontainebleau.

French Government
Tourist Office



FONTANNE

della Porta (1541–1604), Fontana was responsible for the execution of the plans left by the Italian Renaissance artist Michelangelo (q.v.) for the dome of Saint Peter's. With his brother Giovanni Fontana (1540–1614), also an architect, Fontana constructed the Acqua Felice aqueduct and the Acqua Paolo fountain. Because he was suspected of embezzlement of public funds, in 1592 he was dismissed from the papal service by Clement VIII (see *under* CLEMENT). Thereafter Fontana was employed by the viceroy of the Kingdom of the Two Sicilies; in 1600 he designed and supervised the construction of the royal palace in Naples.

FONTANNE, Lynn (about 1887–), Anglo-American actress, born in London, England. She made her London stage debut playing in a Christmas pantomime at the Drury Lane Theatre in 1905, and subsequently acted in other London theaters and with touring companies. Her first American appearance was in New York City in 1910. In 1911 she returned to England and continued her dramatic career there until 1916,

Dame Margot Fonteyn as Juliet in the Royal Ballet production of Sergei Prokofiev's Romeo and Juliet.

Hurok Attractions



when she again toured the United States, playing in many American cities, until 1920. After another year in England, she opened in Chicago, Ill., in 1921 in one of her most noted roles, Dulcinea in *Dulcy* by the American playwrights Marc Connelly and George S. Kaufman (qq.v.). In 1922 she married the American actor Alfred Lunt (q.v.), and after 1924 most of her stage performances were leading roles opposite him. Among the best-known productions in which the couple appeared are *The Guardsman* (1924), *Pygmalion* (1927), *The Taming of the Shrew* (1935), *Idiot's Delight* (1936), *There Shall Be No Night* (1940), *I Know My Love* (1949), *Quadrille* (1954), *The Great Sebastians* (1956), and *The Visit* (1958).

FONTENELLE, Bernard Le Bovier de (1657–1757), French writer and scientist, born in Rouen. He was educated at the college of the Jesuits at Rouen and studied law but chose a literary career. Before he was thirty he had written dramas, operas, dialogues, short stories, and dissertations on science. The philosophical work *Dialogues des Morts* ("Dialogues of the Dead", 1683) established his reputation as a man of letters, and in 1691 he was admitted to the Académie Française. From 1699 until 1739 he served as secretary of the Académie des Sciences, writing during that time several works dealing with the history of the academy. He became particularly well known for these and other writings on science. His most important works attempted to popularize the scientific learning of his age. In his greatest work, *Entretiens sur la Pluralité des Mondes* ("Conversations on the Plurality of Worlds", 1686), he presented the astronomical principles of the Copernican system (q.v.) in a clever literary form. In other writings he attacked superstitious religious beliefs and fables. Fontenelle's questioning attitude predated the inquiring spirit of the 18th-century Enlightenment; see ENLIGHTENMENT, AGE OF.

Fonteyn, Margot, in full DAME MARGOT FONTEYN DE ARIAS (1919–), British ballerina, born Margaret Hookham in Reigate, Surrey, England. She enrolled in a London ballet school in 1927, and later studied ballet with the Russian teacher and dancer Seraphima Astafieva (1876–1934). In 1934 she became a member of the Vic-Wells Ballet, a company later called the Sadler's Wells Ballet and in 1956 renamed the Royal Ballet. Her progress was rapid, and, within the year, she danced her first solo role. In 1935, when the famed British ballerina Alicia Markova (1910–) left the company, Margot Fonteyn succeeded to many of her roles. By 1940 she was prima ballerina of the Sadler's Wells company. She made

her American debut in New York City in 1940. Her dancing is characterized by a high degree of technical proficiency. In 1954 she became president of the Royal Academy of Dancing. Two years later she was created Dame of the British Empire. Dame Margot is highly regarded, especially for her role of Princess Aurora in *The Sleeping Beauty*.

See **BALLET: 20th Century.**

FOOCHOW, formerly MINHOW, city in China, and capital of Fukien Province, on the Min R., about 35 mi. inland from the East China Sea, and about 350 miles s.w. of Shanghai. Foochow is comprised of an old walled city that extends inland for about 2 mi. from the riverbank and a modern commercial town along the river. Bridges, including a 440-yd.-long bridge, purportedly built in the 14th century, connect the riverside area with Nantai, a large island in the river which was formerly the business center and a foreign settlement. Foochow is the outlet for the products of the Min R. area. Since the early 1950's, the Chinese Communist government has made efforts to stimulate industrial development. Paper manufacturing and lumber processing, particularly of pine from the hills of the Min valley, are two important industries fostered by the government. Rail connections were established with the rest of China in 1958. Foochow has several major educational institutions, including a university, a medical school, and an

agricultural college. It is the site of several temples and pagodas, considered outstanding examples of Chinese architecture; see **CHINESE ART**. Kuliang, a noted summer resort, is just outside the city.

The old section of Foochow dates from the T'ang Dynasty (618–906). The city was one of the original five Chinese ports opened to foreign commerce by the Treaty of Nanking in 1842. In the late 19th century, Foochow was the chief exporter of Bohea tea, a black tea then popular in Great Britain and the United States; see **TEA**. The city was called Minhow from 1934 to 1943. Pop. (1970 est.) 900,000.

FOOD, anything eaten to satisfy appetite and to meet physiological needs for growth, to maintain all body processes, and to supply energy to maintain body temperature and activity.

Classes of Foods. The major chemical constituents of foods are the nutrients: protein, carbohydrate (qq.v.), vitamins (see **VITAMIN**), minerals, and fats (see **FATS AND FIXED OILS**), together with pigment, enzymes (qq.v.), flavor substances, and fiber. Because foods differ markedly in the amount of these constituents they contain, they are classified on the basis of their composition and the source from which they are derived. Several different ways of classifying

An African fisherman dries his catch before smoke-curing it. Drying is one of the earliest methods of food preservation.

United Nations



FOOD

foods exist; the following classification has been widely adopted. *Plant origin*: (1) cereals and grain products, (2) starchy roots and tubers, (3) legumes and legume products, (4) nuts and seeds, (5) vegetables and vegetable products, (6) fruit, and (7) sugars and syrups; *animal origin*: (8) meat and poultry, (9) eggs, (10) fish and shellfish, and (11) milk and milk products; *others*: (12) fats and oils, (13) beverages, and (14) miscellaneous.

Formerly, the term food was used to describe any solid form of nourishment in contrast to liquids that could be drunk. Water is essential for life, but it is not usually considered a food; tea, coffee, and alcohol are stimulants. If sugar and milk or cream are added to tea and coffee, they become sources of calories and other nutrients. Alcohol has an energy value of 7 kilogram calories per gram, in comparison to carbohydrate, protein, and fat with respective values of 4, 4, and 9 kilogram calories per gram. Fruit juices may be important sources of vitamin C; any drink to which sugar has been added is a source of calories.

Food Preferences. Food acceptance differs markedly among racial, ethnic, and national groups; food that is highly acceptable to one

group may be repulsive to another. These attitudes are influenced largely by long tradition and the kind of foodstuff originally available in a given geographic area. Food acceptance and methods of preparation are part of the cultural patterns of all people, and food habits are deeply rooted in each culture. Custom, religious influences, rituals and taboos, ceremonial occasions, availability, economic ability to purchase food, and equipment for cooking and serving food in the home all influence determination of the food habits of individuals and groups. Food is also rich in symbolism. Expensive or scarce foods are a mark of social status and prestige. Food is used to symbolize friendship, recognition of special events, celebration of birthdays and holidays, approval of achievement, continuity of tradition, and the love of a mother for her family. Psychological and emotional factors also influence food acceptance. Although sensory reactions to taste, odor, texture, and color of food are individual variables, they are major factors in food choices. Finally, food is used to satisfy emotional needs; joy, anxiety, fear, or feelings of insecurity may influence the kind and amount of food eaten by an individual.

Evolution of Food. Man's food has changed through the centuries. Early man ate whatever he could find, subsisting on the seeds, fruit, and berries he gathered and on the animals or fish he could kill. Sometimes he feasted; at other periods he went hungry. As civilization progressed, man learned to domesticate certain animals and to grow his own food: he evolved from a hunter and food-gatherer to a food-producer. Today's society demands what modern food technology makes possible, a year-round supply of all kinds of food, safe, wholesome, and consistent in quality and texture. In addition, the homemaker wants foods that are ready to serve or that require a minimum of preparation. This has led to many developments in food processing and preservation. Modern foods are preserved by dehydration, smoking, freezing, freeze-drying, canning, irradiation, and pickling, are packed in a variety of containers and materials, and are often precooked. To maintain quality, stability, nutritive value, and consumer appeal, a number of chemical substances are used. Known as food additives, they serve a variety of functions. Some are used as seasonings or to accentuate flavor; some preserve or improve color; others maintain the quality, texture, and keeping qualities and prevent staling and oxidation or the development of off-flavors; see **FOOD PRESERVATION**. Other additives are used to increase the nutritive value by enriching bread

A small Vietnamese girl of a Montagnard tribe pounds grain for the family meal, using much the same method as did her ancestors. UPI



In the Soviet Union diners enjoy a spicy bread stone-baked in flat, round loaves. UPI



and flour with vitamins (riboflavin, thiamine, and niacin) and minerals (iron) or by fortifying milk with vitamin D, margarine with vitamin A, salt with iodine, juices with vitamin C, and breakfast cereals with minerals and vitamins. The kind and amount of food additives used are regulated by the Food and Drug Administration (q.v.) of the United States Department of Agriculture and by the recommendations of such advisory bodies as the Food Protection Committee of the National Academy of Science—National Research Council.

Nutritional Value. No single foodstuff supplies all the nutrients required for the maintenance of nutritional health. Some foods are high in a single nutrient, while others are good sources of several nutrients; thus, a combination of foods that will supply all the nutrients is the desirable goal for daily meal choices. A practice guide to aid in achieving this goal has been prepared by nutritionists in the U.S. Department of Agriculture. This guide recommends that daily food selections be made to include foods from each of the following four food groups: (1) milk group; (2) meat group: beef, veal, pork, lamb, poultry, fish, and eggs; (3) vegetable-fruit group: dark green or deep yellow vegetables, citrus fruit or other vitamin C-rich fruits or vegetables, and other fruits and vegetables; and (4) bread-cereals group: whole-grain or enriched. Selection from these food groups allows for a wide variety of choices. No single food pattern will achieve optimal nutritional health; neither is the

number of meals or frequency of eating the determining factor. Selection of foods based on

Greek soldiers roast whole lambs near their camp. Lamb is a popular food in Greece, and many national dishes are centered around it. UPI



FOOD

their nutritive value and a daily intake in an amount to provide sufficient calories for growth of children and maintenance of weight in adults should be the determinants of food choices.

Foods that are high in proteins of good quality—that is, those containing all the essential amino acids—are frequently the more expensive foods; the world supply of protein foods is inadequate. Because of the general growth of population, extensive research aims to develop new food sources of protein, to make better use of available foods, and to prepare concentrates that can be used as supplements. Some of these food products are fish protein concentrates, proteins extracted from leaves and grasses, and concentrates from such oilseeds as soybean, peanut, coconut, cottonseed, and sunflower and sesame seeds. Other such products are balanced mixtures of cereals and legumes, yeasts grown on hydrocarbon residues, and algae. Except for cereals and legumes, none of these products currently plays a major role in the diet of man. See NUTRITION, HUMAN.

Food Poisoning. The tissues of some plants and animals—some mushrooms (see MUSHROOMS: *Poisonous Mushrooms*) and tropical fish, for example—contain substances poisonous to man. A few food plants also carry poisons. Tapioca (see CASSAVA) may be made from roots that contain hydrocyanic acid (q.v.); inadequate cooking leaves some poison in the product. Careless processing of normal foods may allow the growth of poisonous substances. Bacteria that produce toxic secretions may develop in improperly preserved sausages or in creamy or gelatinous foods inadequately refrigerated; see BOTULISM; PTOMAINES. Such poisons as arsenic and lead may contaminate foods during commercial processing. See also FOOD PRESERVATION; POISON: *Kinds of Poison*.

Preparation of Food. Cooking of food dates back to man's discovery of fire. The earliest cooking methods probably consisted of placing food in hot ashes, on a hot stone, or on a stick held to the flames. Basic modern methods utilize dry heat (roasting, baking, and broiling), moist heat (boiling, stewing, and steaming), and hot fat (frying); microwave cooking is a recent development. Cooking produces such beneficial changes in food as the destruction of toxic organisms in or on the surface of the product; the tough fibers of meat and vegetables are softened, making them easier to chew; the starch granules of flour and other cereal products are ruptured and gelatinized; the enzymes naturally present are destroyed, and the food therefore keeps longer. Many foods are made more appe-

tizing by the cooking process, which develops aromas and flavors and changes their appearance and eye appeal. Not all foods need to be, or should be, cooked; the texture, color, and flavor of many raw fruits or vegetables are highly acceptable. The heat of cooking may destroy some vitamins; the high temperatures used in baking and commercial processing may destroy some of the essential amino acid, lysine, in protein foods. Water-soluble vitamins and minerals may be partially lost in the cooking water of vegetables; see COOKERY.

Food Fads. Throughout the ages, man has subscribed to dietary fads, many of which have had no rational basis. Examples are the eating of a variety of insects because of supposed medicinal value, the consumption of garlic to reduce high blood pressure, radishes to cure gallbladder disease, and calves' brains to increase brainpower. More common are such preferences as sea salt over mined salt and raw over refined sugar; on the basis of appearance alone, many people prefer white eggs, but an equal number demand the brown variety. Some fads have had an unrealized factual basis; examples are the eating of liver, rich in vitamin A, for night blindness and anemia; lime juice, rich in vitamin C, to prevent scurvy and the common cold; and foxglove, containing digitalis, to affect heart action. With the growing awareness of the relationship between nutrition and health, a considerable market has come into existence dealing in diet pills, vitamin supplements, and such so-called health foods, as blackstrap molasses, wheat germ, cereals, and dried fruits.

W.J.D. & E.N.T.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, referred to as the F.A.O., specialized agency of the United Nations (q.v.). The general objective of the F.A.O. is to afford freedom from hunger on a world scale by providing an ample and balanced supply of all the products of agriculture, forestry, and fishery at prices that are fair both to consumers and to producers. According to the constitution of the F.A.O., its specific objectives are "raising levels of nutrition and standards of living . . . and securing improvements in the efficiency of the production and distribution of all food and agricultural products . . .".

Functions of the F.A.O. include collecting, analyzing, and distributing information about nutrition, food, and agriculture; fostering conservation of natural resources; and promoting adequate national and international agricultural-credit policies and international agricultural-commodity arrangements. The organiza-

tion has headquarters in Rome, Italy, and regional offices in Washington, D.C.; Cairo, Arab Republic of Egypt; Bangkok, Thailand; Mexico City, Mexico; Rio de Janeiro, Brazil; and Santiago, Chile. It also maintains an information office in New Delhi, India, and liaison and information offices at U.N. headquarters in New York City. Membership in 1975 was 131. The conference, one of the two governing bodies, meets during alternate years; it elects the director-general, sets policy, and determines program, funds, and scale of contributions. Member nations have one vote each. The other governing body, called the council, is comprised of forty-two member nations elected by the conference. The council acts as the interim governing body, meeting one to three times annually. The secretariat has 6000 staff members, including about 2060 experts and technicians working on field projects, and its director-general. The annual budget for the F.A.O., which represents contributions by the member nations, was about \$107,000,000 in the mid-1970's.

The F.A.O. originated at a conference called by President Franklin D. Roosevelt (q.v.) and held in Hot Springs, Va., in May, 1943. The forty-four nations represented established the United Nations Interim Commission on Food and Agriculture. This commission convened a conference in Québec, Canada, in October, 1945, at which time the F.A.O. was established.

Subsequently the F.A.O. sponsored the shipment of hybrid corn seed to European and Near Eastern countries; it also provided seeds of trees, fiber plants, forage crops, grasses, cereals, and other vegetables to European and Asian countries for the improvement of native forests and crops. It organized demonstration schools for livestock breeding and for research in the causes and prevention of disease in farm animals and in control of insect pests.

Among other projects of the F.A.O. are the development of basic soil and water resources; the international exchange of new types of plants; the control of animal and plant diseases; and the provision to needy member nations of technical assistance in such fields as nutrition, food preservation, irrigation, fertilizer production, soil conservation, and reforestation. In recent years, the F.A.O. has worked extensively to develop new plant mutations by using radioactive materials and to aid developing nations in cultivation of fast-growing varieties of crops such as rice and wheat.

In 1974 the F.A.O. helped organize the World Food Conference, held in Rome, which consid-

ered the critical problem of maintaining adequate food supplies. On the recommendation of the conference, the F.A.O. expanded its information-gathering services to facilitate improved worldwide food security.

FOOD AND DRUG ADMINISTRATION (F.D.A.), agency of the United States Department of Health, Education, and Welfare. Part of the Public Health Service (q.v.), the F.D.A. administers the Federal Food, Drug, and Cosmetic Act of 1938 and related laws to insure that foods are pure and wholesome and produced under sanitary conditions; that drugs and therapeutic devices are safe and effective for their intended uses; that cosmetics are safe and made from appropriate ingredients; and that labels and packaging of products are truthful, informative, and not deceptive. The F.D.A. also enforces the Federal Hazardous Substances Act to insure proper labeling and safety of chemical products, toys, and other articles used in the home. In 1969 the agency became responsible for promoting sanitation of public eating places and interstate travel facilities and for Federal-State programs to insure safety of milk and shellfish.

In 1971 the F.D.A. was given responsibility for enforcing the Radiation Control for Health and Safety Act of 1968. This law was designed to prevent unnecessary human exposure to radiation from electronic equipment ranging from television receivers to dental X-ray machines. In 1972 the agency was assigned to regulate biologic drugs, including vaccines, antitoxins, and serums.

The Federal Food, Drug, and Cosmetic Act prohibits interstate traffic in adulterated or misbranded products. Defective products may be voluntarily destroyed or recalled from distribution by shippers, or seized by U.S. marshals on court orders obtained by the F.D.A. Persons responsible may be prosecuted in the Federal District Courts or enjoined from further violations. All court proceedings are brought by U.S. district attorneys on evidence supplied by the F.D.A.

Inspection activities are centered at nineteen district laboratories in major cities. The F.D.A. inspectors periodically visit facilities and warehouses, and the chemists employed by the agency analyze the samples that inspectors collect. Facts so determined are the basis of regulatory decisions.

Specific products must be approved for safety prior to sale or use. Manufacturers submit samples of production batches of antibiotic drugs, insulin, or color additives to F.D.A. laboratories for testing. The agency must certify their purity,

FOOD MANUFACTURE AND PROCESSING

potency, and safety before they may be shipped. New drugs and their labeling must be approved for safety and effectiveness. Food additives must be generally recognized as safe or proven safe by scientific tests. Residues of pesticide chemicals in food commodities must not exceed safe tolerances, which are set and enforced by the F.D.A. Such premarketing clearances are based on scientific data provided by manufacturers, subject to review and acceptance by the F.D.A. scientists.

The F.D.A. maintains extensive educational programs in order to promote compliance by industry with its regulations and to enable consumers to benefit from its work. See HEALTH, EDUCATION, AND WELFARE, DEPARTMENT OF.

FOOD MANUFACTURE AND PROCESSING.

See BREAD; CHEESE; CONFECTIONERY; FLOUR; FOOD; FOOD PRESERVATION; HYDROGENATION; ICE CREAM; MEAT; PACKING INDUSTRY; SUGAR.

FOOD POISONING. See BOTULISM; POISON:

Kinds of Poison; PTOMAINES; SALMONELLA.

FOOD PRESERVATION, processes involved in protecting food against microbes and other spoilage agents to permit its future consumption; see BACTERIA. The preserved food should retain palatable appearance, flavor, and texture, as well as its original nutritional value.

A wide variety of agents is potentially destructive to the agreeable or salutary characteristics of fresh foods. Microorganisms, such as bacteria and fungi (q.v.), rapidly spoil food. Enzymes (q.v.), which are present in all raw food, are catalytic substances which promote degradation and chemical changes affecting especially texture and flavor. Atmospheric oxygen may react with food constituents, causing rancidity or color changes. Equally as harmful are infestations by insects and rodents, which account for tremendous losses in food stocks. No single method of food preservation affords protection against all hazards for an unlimited period of time. Canned food stored in Antarctica near the South Pole, for example, remained edible after 50 years of storage, but such long-term preservation cannot be duplicated in the hot climate of the tropical zone. Besides canning and freezing, traditional methods of preservation include drying, salting, and smoking. Freeze-drying is a more recent method. Among recent experimental techniques are the use of antibiotics (q.v.) and exposure of foods to nuclear radiation; see RADIATION.

Canning. The process of canning (q.v.) is sometimes called sterilization, because the heat treatment of the food eliminates all microorganisms that can spoil the food and those that are

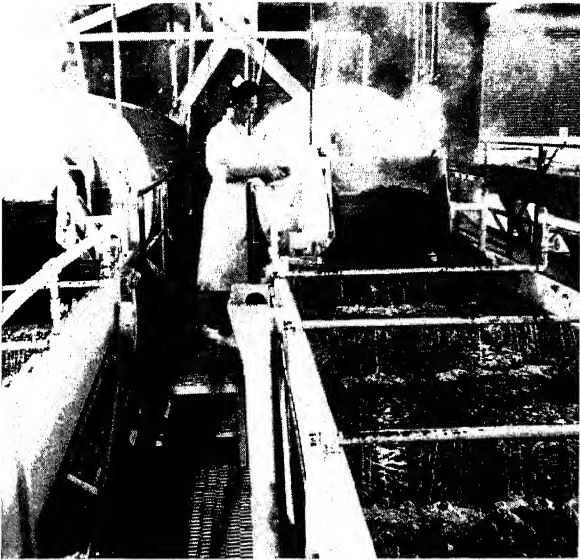
harmful to man, including directly pathogenic bacteria and those that produce lethal toxins. Most commercial canning operations are based on the principle that bacteria destruction increased tenfold for each 18° F. (10° C.) increase in temperature. Food that is exposed to high temperatures for only minutes or seconds retains more of its natural flavor. In the Flash 18 process, a continuous system, the food is flash-sterilized in a chamber in which atmospheric pressure is maintained at 18 lb. per sq.in. to prevent the superheated food from boiling while it is placed in containers. Further application of sterilizing temperature is not required.

Freezing. Although prehistoric man stored meat in ice caves, the food-freezing industry is more recent in origin than the canning industry. Freezing was utilized commercially for the first time in 1842, but large-scale food preservation by freezing began at the end of the 19th century with the advent of mechanical refrigeration (q.v.).

Freezing preserves food by preventing microorganisms from multiplying. Because the process does not kill all types of bacteria, however, those that survive reanimate in thawing food and often grow more rapidly than before freezing. Enzymes in the frozen state remain active, although at a reduced rate. Vegetables are blanched or heated in preparation for freezing in order to ensure enzyme inactivity and thus to avoid degradation of flavor. In the freezing of meats various methods are used depending upon the type of meat and the cut. Pork is frozen soon after butchering, but beef is hung in a cooler for several days to tenderize the meat before freezing.

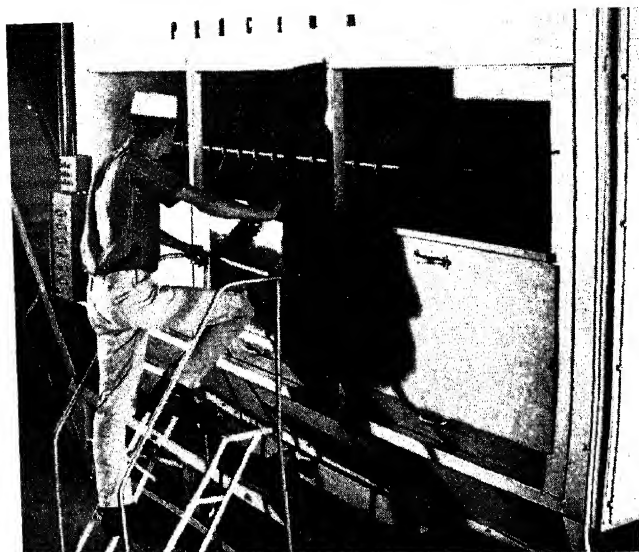
Frozen foods have the advantage of resembling the fresh product more closely than the same food preserved by other techniques. Frozen foods also undergo some changes, however. Freezing causes the water in food to expand and tends to disrupt the cell structure by forming ice crystals. In quick freezing the ice crystals are smaller, producing less cell damage than in the slowly frozen product. The quality of the product, however, may depend more on the rapidity with which the food is prepared and stored in the freezer than on the rate at which it is frozen. Some solid foods that are frozen slowly, such as fish, may show upon thawing a loss of liquid called drip; some liquid, slowly frozen foods such as egg yolk may become coagulated.

Because of the high cost of refrigeration, frozen food is comparatively expensive to produce and distribute. High quality is required in frozen food to justify the added cost in the market.



The freezing process. Top, left: Fresh green beans in the receiving area of a freezing plant. The beans, like other vegetables, are placed in forage boxes at rear, which feed them into the plant on conveyor belts. Above, left: Beans are blanched in rotating drum-shaped machines to inactivate natural enzymes. After blanching, vegetables are fed into tanks and cooled with a constantly changing flow of water. Top, right: Automatic machinery weighs and packages beans, and sealed packages are placed on trays. Right: Trays of packaged vegetables are inserted in a multiplate freezer and frozen in approximately two hours.

General Foods



The dehydration process. Vegetables pass through a multistage dryer under varying degrees of heat until they are completely moisture-free. General Foods

Consumer-size packages of frozen food generally weigh from 9 oz. to 2 lbs. In one type of freezer used for packaged foods the packages are transported mechanically on a belt through an air blast, which produces temperatures as low as -40°F . Another type of freezer, used in the freezing of concentrated orange juice, contains a secondary refrigerant, such as calcium-chloride brine, as a spray or a bath for the cans at temperatures of -20°F . (-29°C). In a widely used freezer called the plate freezer, the packages are in contact with hollow metal plates containing a refrigerant and are subjected to pressure in order to increase the rate of freezing.

This method of preservation is widely used for a great variety of foods, including bakery goods (both ready to eat and to be cooked when desired), soups, and precooked complete meals.

Drying and Dehydration. Although both these terms are applied to the removal of water from food, to the food technologist "drying" refers to natural desiccation, such as spreading fruit on racks in the sun, and "dehydration" designates drying by artificial means, such as a blast of hot air. In freeze-drying a high vacuum is maintained in a special cabinet containing frozen food until most of the moisture has sublimed. Removal of water offers excellent protection against the most common causes of food spoilage. Microorganisms cannot grow in a water-free environment, enzyme activity is absent, and most chemical reactions are greatly retarded. Because of this last characteristic, dehydration is preferable to canning if the product is to be stored at a high temperature.

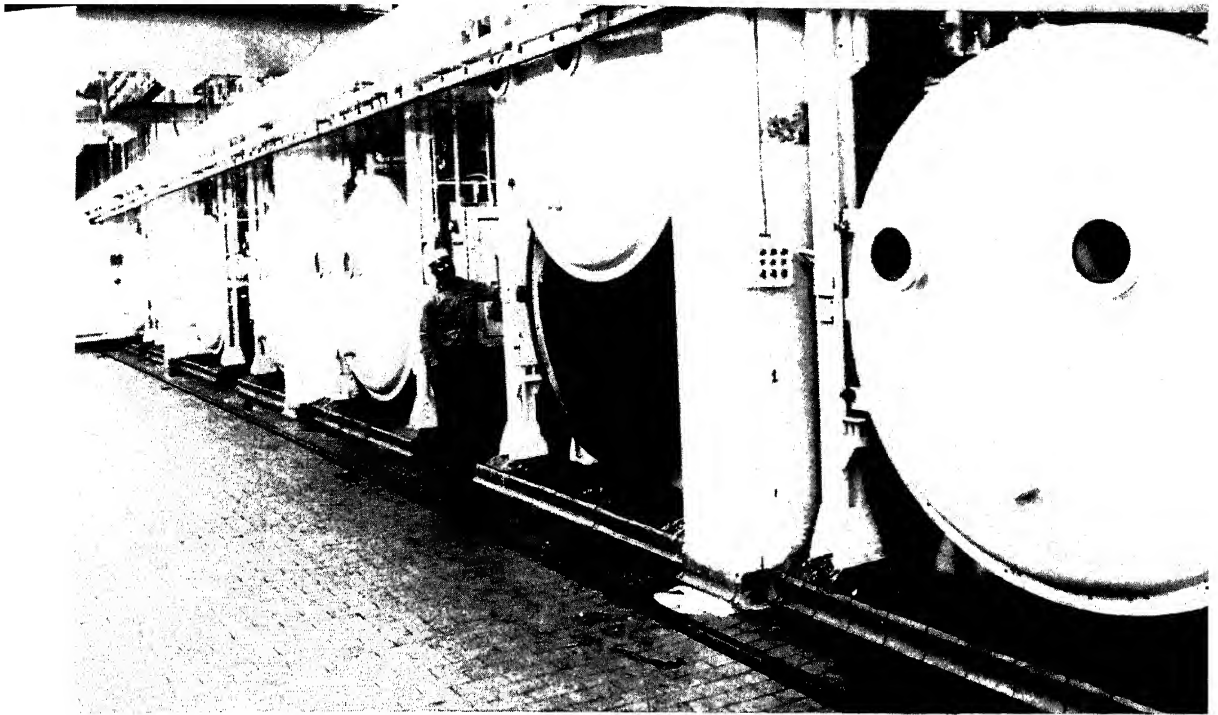
In order to achieve such protection practically all of the water must be removed. The food then must be packaged in a moisture-proof container to prevent it from absorbing water from the air. For this reason a hermetically sealed can is frequently used to store dry foods. Such a can offers the further advantage of being impervious to external destructive agents such as oxygen, light, insects, and rodents.

Vegetables, fruits, meat, fish, and some other foods, the moisture content of which averages as high as 80 percent, may be dried to one fifth of the original weight and about one half of the original volume. The disadvantages of this method of preservation include the time and labor involved in rehydrating the food before eating. Further, it may be difficult to reconstitute the dried product, for the latter absorbs only about two thirds of its original water content; this phenomenon tends to make the texture tough and chewy.

Drying was used by prehistoric man to preserve many foods. Large quantities of fruits such as figs have been dried from ancient times to the present day. In the case of meat and fish, other preservation methods, such as smoking or salting, which yielded a palatable product, were generally preferred. Commercial dehydration of vegetables was initiated in the United States during the Civil War but, as a result of the poor quality of the product, the industry declined sharply after the war. This cycle was repeated with subsequent wars, but after World War II the dehydration industry thrived. This industry is confined largely to the production of a few dried foods, however, such as milk, soup, eggs, yeast, and powdered coffee, which are particularly suited to the dehydration method.

Present-day dehydration techniques include the application of a stream of warm air to vegetables. Protein foods such as meat are of good quality only if freeze-dried. Liquid food is dehydrated usually by spraying it as fine droplets into a chamber of hot air, or occasionally by pouring it over a drum internally heated by steam.

Miscellaneous Methods. Other methods or a combination of methods may be used to preserve foods. Salting of fish and pork has long been practiced, using either dry salt or brine. Salt enters the tissue and, in effect, binds the water, thus inhibiting the bacteria which cause spoilage. Another widely used method is smoking, which frequently is applied to preserve fish, ham, and sausage. The smoke is obtained by burning hickory or a similar wood under low draft. In this case some preservative action is



provided by such bactericidal chemicals in the smoke as formaldehyde and creosote, and by the dehydration which occurs in the smoke-house. Smoking usually is intended to flavor the product as well as to preserve it.

Sugar, a major ingredient of jams and jellies, is another preservative agent. For effective preservation the total sugar content should make up at least 65 percent of the weight of the final product. The sugar, which acts in much the same manner as salt, inhibits bacterial contamination after the product has been heated. Because of its high acidity, vinegar acts as a preservative in pickling relishes and other foods which have been heated. Fermentation (q.v.) caused by the activity of certain microorganisms, such as molds and yeasts, is the basis of preservation in sauerkraut and cheese.

Many chemical preservatives used to prolong the shelf life of foods have been prohibited by the U.S. government as being injurious to the health. Benzoate of soda, which is restricted to concentrations of not more than 0.1 percent, is usually used in fruit products such as apple juice to afford protection against yeasts and molds. Sulfur dioxide, another chemical preservative permitted in most States, helps to retain the color of dehydrated foods. Calcium propionate may be added to baked goods to inhibit mold.

Other modern food-preservation techniques include the use of microwaves, or electromagnetic radiations (q.v.). The intense microwave energy is absorbed by the water in food, and the energy is converted into heat. The temperature

In freeze-drying, frozen coffee is dried by a vacuum process in huge circular drums, leaving crystals of coffee concentrate.

General Foods

of food exposed to microwaves may reach its boiling point within seconds.

Production Statistics. Production of most categories of canned and frozen foods has increased in the past decade, partly because of population gains. In the U.S., about 100,000,000 tons of canned, frozen, and specially packaged foods, valued at \$50,000,000,000, are processed annually. Between 1950 and 1967, production of frozen foods increased from about 3,000,000,000 lb. to more than 16,000,000,000 lb., with the greatest gains being in meats, poultry, and potato products. Production of canned vegetables, juices, and fruits during the same period increased from about 8,170,000,000 cans to approximately 10,700,000,000 cans. M.P.S.

FOOL'S GOLD *See FRUIT.*
FOOL'S PARSLEY, common name for a European weed, *Aethusa cynapium*, belonging to the Parsley family Umbelliferae. It was introduced into the United States and is now common from New England to Minnesota. A small annual plant resembling parsley, the roots and seeds contain a poisonous alkaloid, which is a menace to stock grazing in pasturelands.

FOOT, in human anatomy, lowest structure on the leg, consisting of twenty-six bones and resembling the hand. Seven thick, short, tarsal bones compose the heel and back of the instep; five parallel metatarsal bones, which form the front of the instep, spread toward the front of the foot to form the ball. Fourteen smaller pha-

FOOT

langes make up the toes; the large toe is composed of two, while each smaller toe is made up of three. All the bones are firmly connected by tough bands of tissue called ligaments; the plantar ligament runs from the heel bone to the metatarsals, keeping the bones in place. Movements of the foot are controlled by leg muscles.

The tarsal and metatarsal bones form the two arches of the foot: the plantar arch running from the heel to the ball and normally touching the ground only at each end, and the metatarsal arch across the ball of the foot. With the thick layer of fatty tissue under the sole, these flexible arches absorb pressure and the shocks of walking and jumping.

The foot is subject to numerous disabilities, including athlete's foot (q.v.), a fungus infection, and flatfoot, caused by weakened muscles and ligaments of the arch. Most serious is club-foot (q.v.), a deformity caused by shortening of muscles and tendons. See BUNION; PODIATRY.

FOOT, in poetry. See VERSIFICATION.

FOOT-AND-MOUTH DISEASE, or **HOOF-AND-MOUTH DISEASE** or **APHTHOUS FEVER**, contagious febrile disease of animals and, rarely, of man. Caused by a virus, it affects cloven-hoofed animals such as cattle, swine, sheep, goats, and deer, often causing epizootics (epidemics). The disease is characterized by a sudden rise in temperature, followed by an eruption of blisters occurring in the mouth, on areas of tender skin such as the udder in females, and on the feet; blisters may also appear in the nostrils. Salivation and frequent smacking of the lips accompany the eruption. The blisters grow larger and then break, exposing raw, eroded surfaces. Eating becomes difficult and painful, and because the soft tissues under the hoof are inflamed, the animal invariably becomes lame and the hoofs may be shed from the feet.

Although seldom fatal to adult animals, the disease is extremely destructive. Livestock raised for meat lose much weight, and dairy cattle and goats give less milk. Often the disease kills very young animals and causes pregnant females to abort. The crippling effect of the disease is a very serious matter in countries where oxen are used as draft animals.

A single case carries the threat of economic catastrophe because the disease is highly contagious. Through fluid and coverings from the blisters, through saliva, and probably through excreta, affected animals contaminate any objects with which they come in contact. The virus may be introduced into new areas by meat, hides or other unsterilized animal products. Blood of diseased carcasses retains an in-

fective power for thirty days or more in storage at low temperatures, and marrow bones remain virulent even longer.

Although ancient records are not clear in descriptions of animal diseases, it is possible that foot-and-mouth disease was known in eastern Europe two thousand years ago. Experts believe that the disease is foreign in western Europe and in North America, and that each epidemic has been due to fresh importation of the virus from some other part of the world. In the case of the repeated outbreaks recorded in Germany, France, and Italy in the 17th and 18th centuries, the source is believed to have been eastern Europe or southern Asia. With the growth of world commerce in the 19th century the disease became widely distributed. In 1839 it appeared in England. In 1870 Canada, which had received infected cattle from England, passed on the contagion to the United States, where it spread rapidly through several States. In the same year the first outbreak occurred in South America. Australia had two outbreaks in 1872, but has since remained free of the disease.

The U.S. has experienced nine distinct epizootics; the most serious occurred in 1914, invading twenty-two States and the District of Columbia. The latest outbreak, which occurred in California in 1929, was quickly controlled. Since then no major outbreaks of foot-and-mouth disease have been reported in the U.S.

Nevertheless, foot-and-mouth disease remains a menace to livestock raisers and the meat-packing, dairy, leather, and wool industries. The Agricultural Research Service of the U.S. Department of Agriculture inspects all imported livestock, stock feed, and bedding at points of entry, and is strict in enforcing quarantine regulations; see AGRICULTURE, DEPARTMENT OF. In 1947, for example, a ban was placed on shipments of livestock from Mexico, which formerly sold the U.S. from 400,000 to 500,000 head of cattle a year. To prevent the spread of the disease by feeder stock in the event of a local outbreak within the country, inspectors also examine all livestock transported across State lines. Inspection of imported meat and related products by the Department of Agriculture provides additional safeguards.

Considerable progress has been made toward developing an effective vaccine against foot-and-mouth disease, but the cost of vaccinating all susceptible animals (approximately \$1,000,000,000 annually) would be prohibitive. The vaccine would not eradicate the disease, moreover, and so outbreaks could recur. Consequently the slaughter of all susceptible animals

is the only presently effective countermeasure to foot-and-mouth disease. During the outbreak in Great Britain in 1967 and 1968, for example, 370,630 cattle, sheep, and goats on infected premises and an additional 60,000 animals on nearby premises were slaughtered. See DISEASES OF ANIMALS.

FOOTBALL, outdoor game played by two opposing teams with a ball of various types, usually an inflated bladder or rubber bag in a leather or rubber cover, spherical or ellipsoidal in shape. The object of the game is to score points by carrying the ball across the goal line of the opponents, or by kicking the ball through or over the goal of the opponents. The principal types of football played today are American football; association football, or soccer; Canadian football; Australian football; Gaelic football; and Rugby football.

Football is a game of antiquity, known to many peoples. The ancient Greeks played a form of football known as *harpaston*, and the Romans played a similar game, *harpastum*. In medieval times a form of football known as *calcio* flourished in Italy. Natives of Polynesia are known to have played a variety of the game with a football made of bamboo fibers, and the Eskimo have used a leather ball filled with moss.

Most modern versions of football, however, derive from England, where a form of the game was known in the 12th century. In subsequent centuries football became so popular that various English monarchs, including Edward II and Henry VI (q.v.), forbade the game on the theory that it took interest away from the military sport of archery. Nevertheless, football grew steadily in popularity. At the beginning of the 19th century several types of the game—all permitting players to kick the ball but not carry it—were being played at various English schools, including Eton, Harrow, and Rugby. The modification of the game that permits carrying the ball was first introduced at Rugby in 1823 when a schoolboy named William Webb Ellis disregarded the established rules, tucked the ball under his arm, and dashed across the goal of the opponents. The game of Rugby was born. Thereafter numerous football clubs sprang up in England, some playing the kicking game, others the ball-carrying game. In 1863 a number of clubs devoted to the kicking game met in London, organized the London Football Association, and adopted a code of uniform rules; this type of game was henceforth known as association football, and later soccer, a word that was derived from association. In 1871 a similar group devoted to the ball-carrying game organized the

Rugby Football Union and adopted the rules then in vogue at Rugby School; that form of the game thereafter was known as Rugby football. The two organizations still exist, and each exercises control over its respective game.

In America, a form of football was played, using a blown-up bladder, in the colony of Virginia in 1609. In 1820 Princeton students participated in a soccer-like game, called ballown, in which they advanced the ball by punching it with their fists. Harvard, Yale, Brown, and Amherst also had versions of football-like games, but these contests were little organized and were intraclass, not intercollegiate. Competition between colleges began on Nov. 6, 1869, between two New Jersey schools, Rutgers and Princeton universities. The game, however, resembled soccer more than modern-day American football. Columbia, Cornell, and other Eastern United States colleges soon after sent representative teams into intercollegiate competition with Rutgers and Princeton.

Harvard, preferring to use its own rules, abstained from this competition. In 1874 Harvard met McGill University of Canada in a match played under the Rugby-like rules of the Canadians. The Harvard players, impressed, altered their own rules accordingly. Harvard and Yale played a football game for the first time on Nov. 13, 1875, with rules of Harvard prevailing. About 2000 spectators attended the game in New Haven, Conn., at an admission charge of fifty cents. Harvard won, 4 goals to 0.

The following year, representatives of Harvard, Yale, and Columbia answered an invitation from Princeton football spokesmen to attend a parley at Springfield, Mass. The result of the convention included a new set of football rules and the formation of the Intercollegiate Football Association. Although the Rugby-like rules of Harvard again prevailed, certain soccer rules were incorporated. The resulting combination of Rugby and soccer became popular, and as time went on the rules were constantly changed until a new game evolved. The Intercollegiate Football Association was dissolved in 1894 and in the same year a rules committee, dominated by the Yale graduate and football pioneer Walter Chauncey Camp (q.v.), was formed by the influential Eastern schools. In 1905 an independent association of colleges also formed a rules committee; the two committees soon merged, and since that time American collegiate football has been governed by them.

See also FOOTBALL, AMERICAN; FOOTBALL, AMERICAN PROFESSIONAL; FOOTBALL, GAELIC; RUGBY; SOCCER.

V.T.L.

FOOTBALL, AMERICAN

FOOTBALL, AMERICAN, type of football (q.v.) that developed in the United States in the 19th century from association football, or soccer, and Rugby football (principally the latter). It is one of the most popular American sports.

The Playing Field and the Ball. American football is played on a field of rectangular shape 120 yd. long, including the end zones, and $53\frac{1}{3}$ yd. wide. The field is bounded at each end by an end line marked in white lime across the entire width of the field. The 10-yd. areas at each end of the field are called end zones; it is into this area that a team must carry or pass the ball to score a touchdown. Ten yards from each end line, and 100 yd. from each other, are two goal lines, which are also marked in lime. Similar transverse lines are drawn at 5-yd. intervals throughout the main 100-yd.-long body of the playing field. The lines thus drawn give the field a resemblance to a huge gridiron, and the field is sometimes referred to colloquially as the gridiron. On each end line, situated in the middle of the line, are goal posts, a set of two vertical, parallel uprights extending at least 20 ft. up from the ground and connected by a horizontal crossbar at a height of 10 ft. (Often today the arrangement consists of a single, 10-ft. upright topped by a horizontal crossbar from the ends of which two vertical uprights extend to a height of at least 20 ft. above the ground.) In American college football, the goal posts are 23 ft. 4 in. apart. American professional football rules allow for the placing of the goal posts on the goal line, but the posts are only 18 ft. 6 in. apart. Each side of the field is marked by a line running the entire length of the field and known as the side line.

American football is played by two teams, each made up of eleven players, with a ball consisting of an inflated rubber bladder encased in a leather or rubber cover. The ball is a prolate spheroid, having a circumference of 28–28½ in. about the long axis and 21¼–21½ in. about the short axis; it weighs between 14 and 15 oz.

Offensive Formations. During the game the teams are designated as either the offensive team, that is, the team in possession of the ball, or the defensive team, the team defending a goal line against the offensive team. The eleven players of the offensive team are divided into two groups: seven linemen, who play in the forward line known as the line of scrimmage crossing the field at the point at which the ball is placed in play; and a backfield of four players, called backs, who stand in various positions behind the line. The lineman whose position is in the middle of the line is called the center. On

his left is the left guard and on his right is the right guard. On the left of the left guard is the left tackle, and on the right of the right guard is the right tackle; similarly, on the ends of the line are the left end and the right end. The back who usually stands directly behind the center and directs the play of his team is known as the quarterback; behind him is the fullback; and at the sides of the fullback are the left and right halfbacks. An offensive line in which the linemen are arranged as just described is known as a balanced line, and an offensive backfield so arranged is said to be in a balanced backfield formation, or T formation, thus:

L.E. L.T. L.G. C. R.G. R.T. R.E.

Q.B.

L.H.B. R.H.B.

F.B.

The T formation proved to be the most popular formation in college and high-school football, as well as for many professional teams, throughout the 1940's, the 1950's, and the 1960's. Before the T formation dominated football, the single-wing offense was the most popular attack in use. It dates back to the early 1900's. Some of the best single-wing teams used an unbalanced line and lined up like this:

L.E. L.T. C. L.G. R.G. R.T. R.E.

Q.B. R.H.B.

F.B.

L.H.B.

In the T formation, the center hands the ball under his legs to the quarterback. In the single wing, the center passes the ball under his legs to the left halfback or the fullback. The single wing is known as a power formation because it allows linemen to double up on opponents. The T formation is better for quick movements, deception, and passing. One popular variation of the T formation is the split T formation, in which the linemen as well as the backs split farther apart, that is, line up with more distance between them in order to spread apart the defense and make for wider openings in the line. In modern football, colleges tend to use formations popularized by the professional teams.

Chart Showing Offensive & Defensive Positions & Primary Roles of Football Team Members

DEFENSIVE TEAM (Standard Pro Defense)



TACKLES **T**

Rush passer. Try to stop running plays through middle of line.



CORNER BACKS **CB**

Also called Defensive Halfbacks. Guard pass receivers. Defend against running plays around ends.



ENDS **E**

Rush passer. Defend against running plays.



SAFETY MEN **S**

Last defenders between opponents and goal line. Guard pass receivers. Also come up to line to help defend against running plays.



LINEBACKERS **LB**

Defend against running plays. Guard receivers of short and medium distance passes. Rush passer.

S**S****HB****CB****LB****LB****LB****E****T****T****E**

LINE
OF
OF
SCRIMMAGE

SE**T****G****QB****G****T****TE****FL****HB****FB**

OFFENSIVE TEAM (Pro-Type Formation)



QUARTERBACK **QB**

Calls signals. Throws passes. Hands off ball to running backs. Runs with ball.



SPLIT END **SE**

Also called Wide Receiver. Catches passes, often far downfield.



TIGHT END **TE**

Catches passes. Blocks.



GUARDS **G**

Protect passer. Block for runner, often pulling out of line to run interference.



TACKLES **T**

Protect passer. Block for runner.



CENTER **C**

Begins every play by handing or passing ball back between his legs. Then blocks.



HALFBACK, FULLBACK **HB FB**

Also called Running Backs or Set Backs. Carry ball on running plays. Catch passes. Pass.



FLANKER BACK **FL**

Also called Wide Receiver. Catches passes, often far downfield.



A defensive player tackles the ballcarrier and stops his advance toward the goal line UPI

The pro-type offense was devised to allow for more passing instead of running with the ball. There are several variations, but the common lineup is:

L.E.	L.T.	L.G.	C.	R.G.	R.T.	R.E.
				Q.B.		L.H.B.
				R.H.B.		
				F.B.		

Many other variations exist, as the rules allow teams to line up in any manner they desire on offense as long as there are at least seven men on the front line.

Methods of Scoring. The object of the game is to score a greater number of points than the opposing team. A game can end in a tie if both teams have scored the same number of points at the end of regulation time. Six points are scored for a touchdown, which is made when a player on the offensive team carries the ball beyond the goal line of the opponents or passes to a teammate who catches it in the end zone. A pass receiver may also catch the ball before he reaches the goal line and carry it into the end zone for a touchdown. After a team has scored a touchdown, it is permitted to try for a conversion, that is, an opportunity to score one or two additional points while time is out. The team

lines up 3 yd. from the goal line of the opponents and either runs with the ball, passes it, or kicks it. A running or passing conversion in which the ball is carried across the goal line counts for two points. A conversion by a drop-kick or place-kick that propels the ball between the goal posts and over the crossbar counts for one point.

Another way of scoring is to kick a field goal, which counts three points. A field goal may be scored by means of a dropkick, in which the kicker drops the ball on end to the ground in front of him and kicks it on the rebound (this method is archaic); or a place-kick, in which one player holds the ball upright on the ground for a teammate to kick. For a successful field goal, the ball must be kicked between the goal posts and over the crossbar.

A third form of kick, known as punting, is also employed in football, but it is not valid for scoring a field goal or a point after touchdown. In punting, the kicker drops the ball toward his foot and kicks the ball before it touches the ground. The punt is usually employed as an offensive maneuver.

Finally, two points are scored for a safety, which occurs when an offensive team ends a play in possession of the ball behind its own goal line (the goal line normally behind the team) and the impetus which caused the ball to cross the goal line has been supplied by the defensive, rather than the offensive, team; the two points are scored for the defensive team. If the impetus has been supplied by the offensive

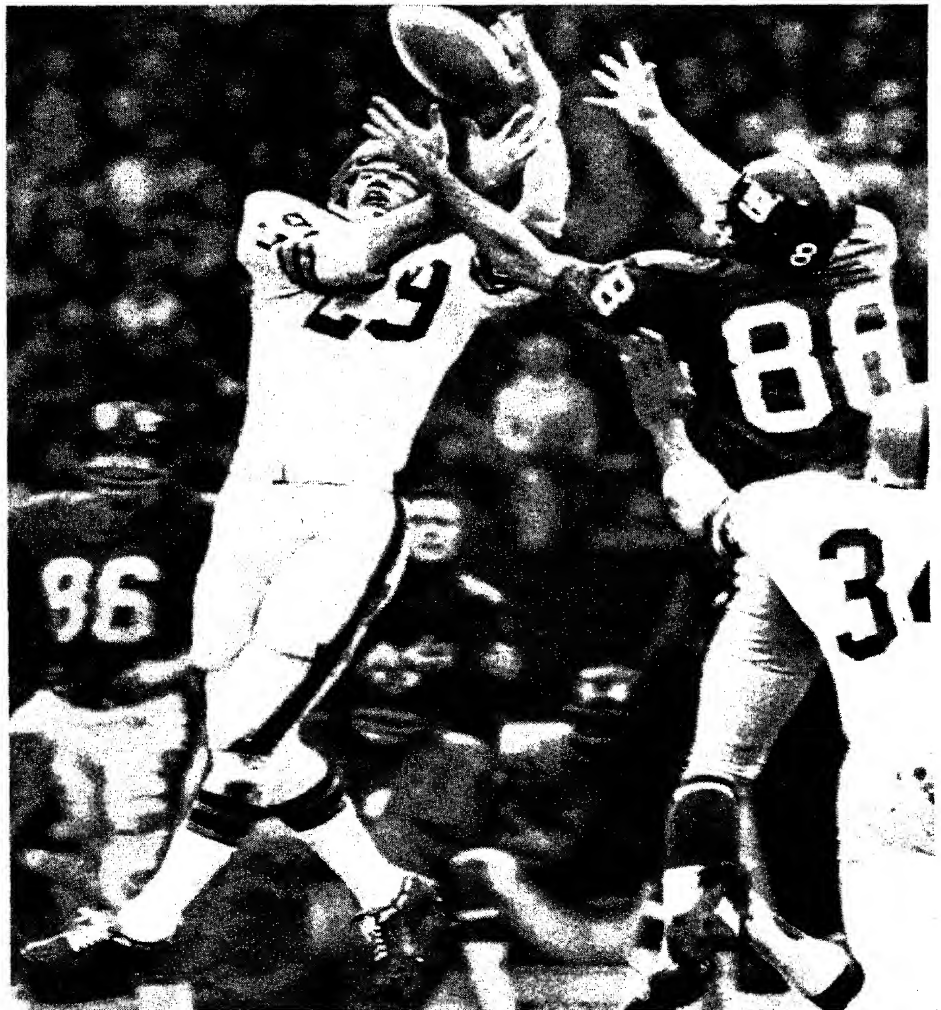
team, the play is known as a touchback and does not count in the scoring. The score of a game won by forfeit is 1-0.

Control of Playing Time. A game of football is played in four periods, or quarters, of 15 min. playing time each. (This applies to college and professional games; high school teams play four 12-min. quarters.) The first two periods constitute the first half; the second two, the second half. Between the halves, a rest period of 15 or 20 min. is permitted the players, who may in that interval leave the field. One minute of rest is permitted between the first and second quarters and between the third and fourth quarters. The teams change goals at the end of the first and third quarters. In view of the often violent bodily contact that characterizes the sport, players wear elaborate protective equipment, including pads for shoulders, kidneys, and hips, and plastic helmets with face guards.

The Officials. Play is supervised by impartial officials. In intercollegiate football the officials consist of a referee, an umpire, a linesman, a field judge, and sometimes a back judge. The

referee is in general charge of the game at all levels of play. He supervises the other officials, decides on all matters not under their specific jurisdiction, and enforces penalties. He carries a whistle that he blows to indicate when the ball is dead (out of play) and when it may again be put into play. The umpire makes decisions on questions concerning the equipment of the players, their conduct, and their positions. He blows a whistle to indicate that a foul has been committed. The principal duty of the linesman is to mark the position of the ball at the end of each play. He has assistants who, under his supervision, measure distances gained or lost, using a device consisting of two vertical markers connected by a chain or cord 10 yd. long. The linesman must particularly watch for violations of the rule requiring players to remain behind the line of scrimmage until the ball is put in play. He carries a whistle to notify the referee of any foul he has noticed. The field judge times the game, using a stopwatch for this purpose. In some cases, the scoreboard has a clock that is considered official.

The forward pass intended for a wide receiver (88) is about to be intercepted by a back on the defending team.
UPI





A moment after the successful completion of a forward pass, the receiver (80) is tackled by a defender. UPI

Game Procedure. Just before a game begins, the referee tosses a coin in the presence of the two team captains. The team winning the toss has its choice of two options: the option of deciding whether to kick off or receive the kickoff; or the option of deciding which goal it will defend. The side that loses the toss accepts the option the winner did not take. The options are reversed at the start of the second half. After each try for point after touchdown and after each successful field goal, the team scored against may choose either to kick off or to receive the kickoff. In kicking off, the ball is put in play by a place-kick from the 40-yd. line of the team about to kick off. The kicking team lines up on or behind its 40-yd. line, and its opponents spread out over their territory in a forma-

tion calculated to enable them to catch the ball and either run it back or kick it back (the latter occurring rarely). Any man on the receiving team may catch the ball, or pick it up on a bounce, and run with it as long as the ball is within the boundaries of the field. As he runs he may be tackled by any of his opponents and stopped, or downed. Tackling involves using the hands and arms to stop or throw to the ground an opponent carrying the ball. A tackler may leave his feet at the moment he touches the runner, but he may not execute a flying tackle, that is, dive or throw his body through the air at the runner. After the tackle, the referee blows his whistle to stop play and places the ball on the spot where the runner has been downed. A scrimmage then takes place.

Before scrimmage begins, the team on the offensive usually gathers in a circle, called a huddle, and the quarterback tells his team which play is to be used next to try to advance the ball. Teams customarily have dozens of well-rehearsed plays to choose from. Some plays have several variations as well. For example, a quarterback who wants to pass the ball has his choice of passing to any of several men on one play. Each play is designated by code numbers or words, called signals. The quarterback transmits these signals to his team while in the huddle. After the team comes out of the huddle, it lines up opposite the opposing team on the line of scrimmage, the imaginary line on which the ball was downed. The center of the offensive team crouches over the ball and the scrimmage begins when, on a spoken signal from the quar-

terback, the center snaps the ball, that is, passes or hands it back between his legs. He may hand the ball to the quarterback, who in turn can pass it, hand it off, or run with it; or the center may pass the ball directly to one of the backs other than the quarterback. The back who receives the ball runs with it, passes it laterally or forward, or kicks it.

The defending team tries to prevent the attacking team from advancing the ball. During the scrimmage, the players of the offensive team may check their opponents by use of their bodies, but they may not use their hands or arms for this purpose. The man running with the ball, however, is allowed to use his outthrust

An offensive back (22) carries the ball straight ahead across the line of scrimmage as a defensive player (left) attempts to tackle him.

UPI



FOOTBALL, AMERICAN

arm to ward off, or straight-arm, potential tacklers. The offensive man checks defenders or tries to force them out of the way by performing the maneuver known as blocking. Good blocking is considered the most fundamental technique in football. The defending players may use their arms and hands in their attempt to break through the opponents' line to reach the man with the ball. The defending team tries to keep the offense from gaining any distance, and it even tries to stop the offense for a loss, by tackling the ball carrier before he reaches the scrimmage line. The team in possession, during this time, must advance the ball 10 yd. in four tries, called downs. After each play, the teams line up again and a new scrimmage takes place. If the team fails to make 10 yd. in four downs, it must surrender the ball to its opponents after the fourth down.

Offensive Strategy. Among the common offensive plays are the line plunge or line buck, in which the runner attempts to carry the ball through the central part of the opponents' line; the off-tackle smash or run, in which the ball carrier tries to get through the opponents' line between either of the tackles and an end; and the end run, in which the man with the ball attempts to run around one of the ends. In all cases the runner is assisted by various teammates, who generally precede him and attempt to block opponents out of his way. The ball carrier is usually one of the halfbacks or the fullback, but the quarterback and even sometimes the ends will carry the ball. On running plays in which he is not the ball carrier, the quarterback gives the ball to the runner by means of a hand-off or a soft, underhand lateral pass, called a pitchout.

Perhaps the most spectacular of the offensive plays is the forward pass, in which the ball is thrown in a forward direction to one of the players eligible under the rules to catch it. The ball is nearly always thrown by one of the backs, and those who may catch it include the other three backs and also the two ends. A forward pass may be made only during scrimmage and then only from behind the line of scrimmage. A lateral pass may be made any time the ball is in play; and anywhere on the field.

In modern football, when a forward pass is thrown, the passer is almost invariably the quarterback. As a result, when one of the other backs throws a forward pass the intention is usually to surprise the opponents. One such pass is the option pass, in which a halfback or fullback receives the ball from the quarterback on a handoff or pitchout and begins a run

around one end; he feints a pass, observes the response of the defenders, and then makes his decision to pass the ball or run with it. The defending team tries to frustrate the forward pass by batting the ball to the ground, deflecting it out of play, or catching it. If the defensive team catches the ball, thereby gaining possession of it, an interception has been made. The defensive player who has caught the ball can try to return it as far toward the opponents' goal as possible, being stopped only when he is tackled or forced out of bounds, that is to run off the field over the side lines. If the forward pass is not completed, that is, caught before touching the ground by an eligible player on the offensive team, or if it is not intercepted, the ball remains in the possession of the offensive team at the point where the last play started (unless the offensive team has used up its four downs). Once a player catches a pass, he may run with the ball or pass it laterally or backward to a teammate, in an attempt to advance the ball to the opponents' goal.

A most important and frequently used play on the part of the offensive team is the punt, which consists in kicking the ball toward the opponents' goal. A punt is often used when the attacking team has failed to gain 10 yd. in the first three downs. By punting on the fourth down instead of trying a running play or a pass, the team often relinquishes the ball much farther from its own goal than if it had tried a run or a pass and had failed to gain the number of yards necessary for a first down. If a punt causes the ball to go out of bounds, that is, to cross either side line, the ball is put into play by the receiving team 15 yd. in from the spot where it crossed the side line. If the punted ball crosses the goal line of the defending team, thereby effecting a touchback, it is put into play by the defending team on its own 20-yd. line. For a punt, the offensive team generally lines up in what is known as punt formation:

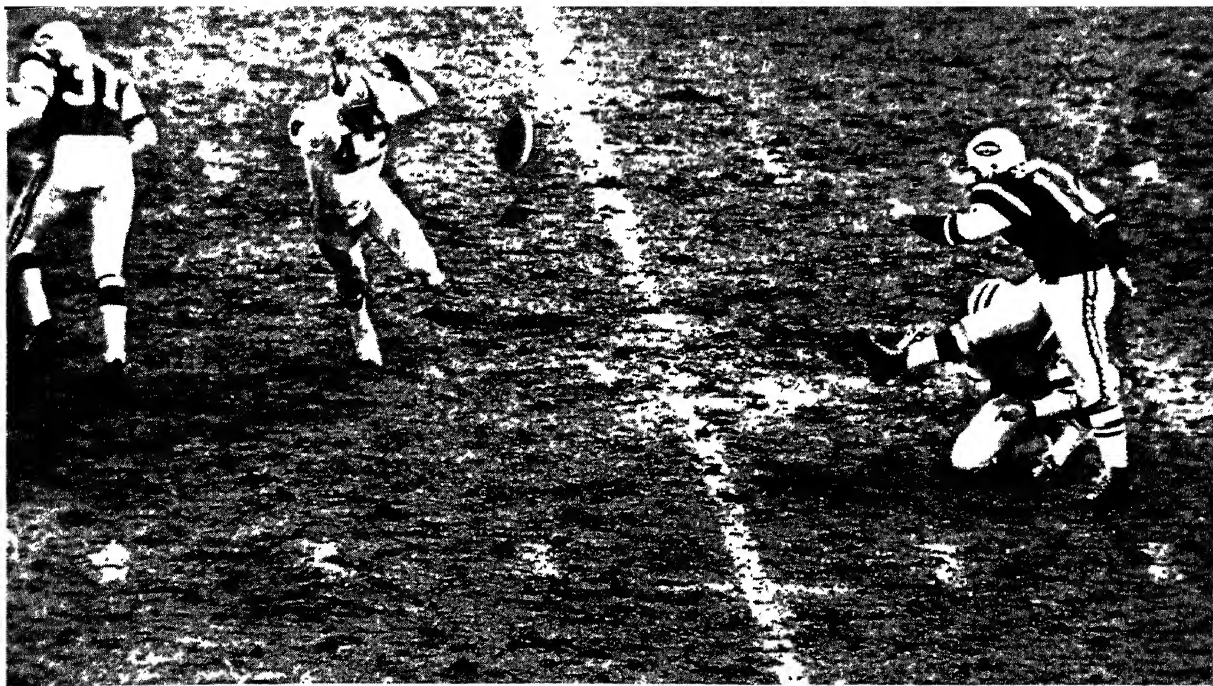
L.E. L.T. L.G. C. R.G. R.T. R.E.

B. B.

B.

K.

The deepest back, designated by K, for kicker, receives the ball from the center and kicks it. Some of the teammates of the kicker station themselves so as to protect him by blocking the charging defenders, and others on the kicking



A place-kicker (right) attempts a field goal as a player (in white) of the defending team tries to block the ball in midair.

UPI

team run downfield to tackle the opponent who will catch the punt and possibly run it back. Sometimes when the offensive team is in kick formation, instead of kicking, as the opponents may expect, it tries a running play or a pass. Often, especially in professional football, teams will try for a field goal instead of punting; the team thus has a chance to score three points, and if the field goal attempt falls short or goes into the end zone, it serves the purpose of a punt.

Defensive Strategy. One striking aspect of modern football is its emphasis on defense as well as offense. This trend began after World War II, when colleges were allowed free substitution of players, that is, a player could enter and leave the game an unlimited number of times, as long as the ball was not in play. This feature of the game led to the modern two-platoon system, in which one group of eleven men enters the game to play offense, and a second group enters to play defense. Such a system obviously fosters the development of individual skills and a high degree of specialization.

Defensive football has acquired an extensive terminology of its own. In some ways defense is more complicated than offense, because defensive teams have few restrictions on their manner of lining up. Generally, however, the defensive formation is determined by the way the offense lines up. For example, when defending against opponents who are expected to throw many forward passes, teams often use a formation with a four-man line of two ends and two tackles, called the front four; three men directly behind them, called linebackers; two men

placed wide and farther back, called defensive halfbacks or cornerbacks; and two men behind them, called safeties:

S. S.

C.B.

C.B.

L.B. L.B. L.B.

E. T. T. E.

Generally, the front four charge the passer or try to keep ball carriers from advancing beyond the line of scrimmage. The linebackers defend against the run and short passes, the cornerbacks attempt to stop passes and guard against wide running plays, and the safeties protect against passes and try to tackle any ball carrier who breaks into the open field. Against a team that primarily runs with the ball, a defensive team may line up in a 6-2-2-1 defense:

S.

H.B. H.B.

L.B. L.B.

E. T. G. G. T. E.

FOOTBALL, AMERICAN

Other popular defenses have been the 7-1-2-1, called the 7-diamond, which stops the run even more effectively; the 5-4-2 defense, used against teams that run and throw short passes; and, more recently, three-man-line formations designed to defend against a team relying heavily on the forward pass.

If a player carrying the ball fumbles it, that is, lets it slip from his grasp, it becomes a free ball. Any player on the field may then recover it, taking possession of it for his team. This feature of the game is of great importance, because it can result in the defensive team's unexpectedly regaining control of the ball.

Penalties. In order to keep the game of football a sportsmanlike contest, penalties are imposed by officials for violations of the numerous rules of the game. Among the most frequent infractions are the following:

Violation	Penalty
<i>Offside</i> , crossing line of scrimmage and making contact with opponent before ball has snapped.	Loss of 5 yd.
<i>Holding</i> a player to prevent his moving to take part in a play. Holding is usually committed by the offensive team.	Loss of 15 yd. when team incurring the infraction is on offense (penalty, 10 yd.). Loss of 5 yd. and automatic first down for the other team when team penalized is on defense.
<i>Tripping or clipping</i> , running or diving into the back, or the back of the legs, of a player not carrying the ball.	For either foul, loss of 15 yd.
<i>Piling on</i> a player already tackled or stopped.	Loss of 15 yd.
<i>Roughing the kicker or passer</i> , or tackling him after he has kicked or passed the ball.	Loss of 15 yd., automatic first down for the other team.
<i>Unsportsmanlike conduct</i> .	Loss of 15 yd.
<i>Pass interference.</i> The defensive team must not push, hold, or in any other way interfere with the player of the offensive team who is trying to catch a pass. The defensive team must confine its attempts at intercepting the ball, or rendering the pass incomplete, only to catching the ball or batting it to the ground.	The pass is called completed at the point of the infraction and the offended team receives an automatic first down. If interference takes place in the end zone, the ball is placed on the 1-yd. line, where the offense receives a first down.
<i>Offensive pass interference.</i> The offensive team must not interfere by pushing, pulling, holding, or using similar means with a defensive player who is trying to intercept the pass or render it incomplete.	The passing team loses 15 yd. from the spot of the preceding down, and the play counts as a down.

Schedules. The present-day game is immensely popular. It is played during the late summer, throughout autumn, and into January. High-school teams usually play about 8 games, colleges about 10 games, and professional teams 14 games in the regular season, plus playoff games and about 6 exhibition games before the

start of the regular season. Generally, teams play one game each week, using the time between games to practice and prepare for the next game.

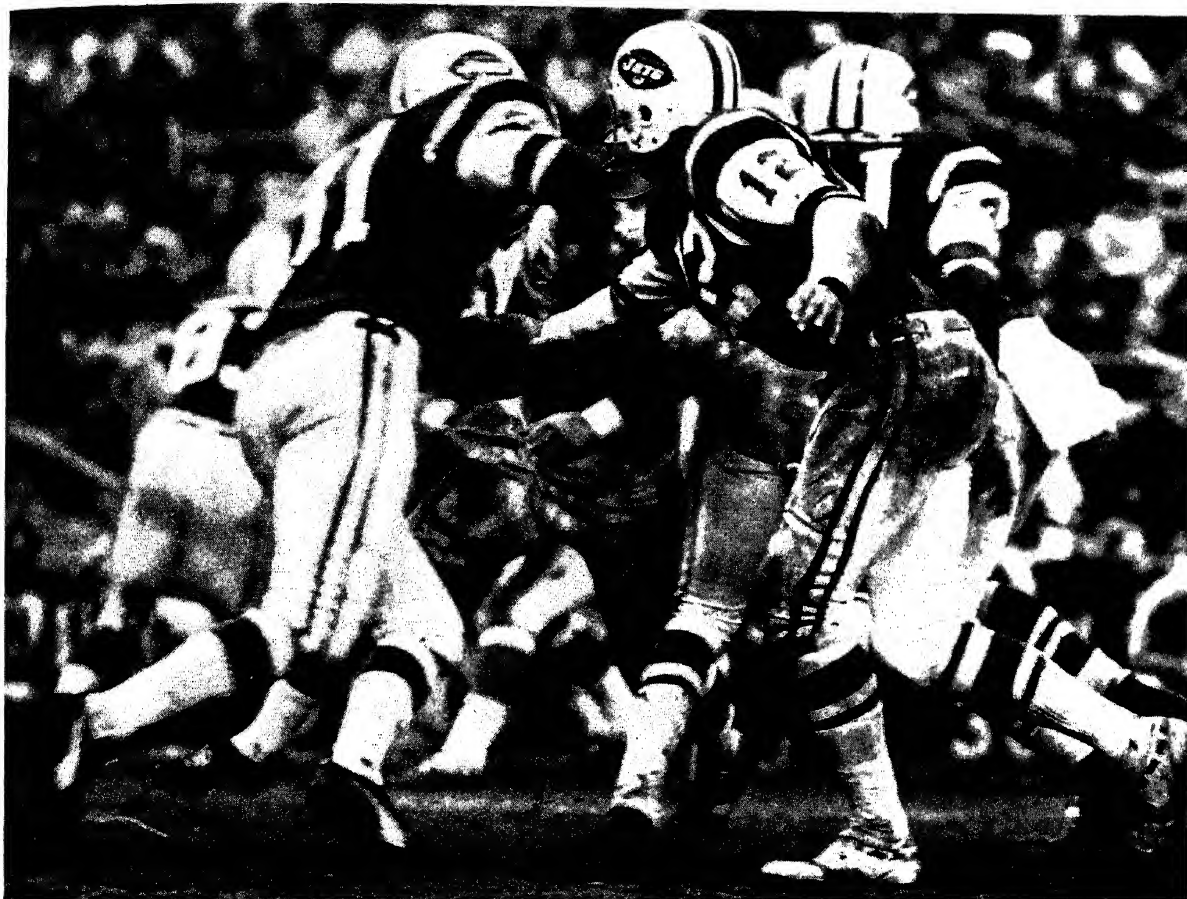
History. American football was made popular by teams representing colleges and universities. These teams dominated the game for most of the first hundred years of football in the U.S. Even today, despite greatly increased interest in professional football, intercollegiate contests, played by some 600 teams, are attended by more than 27,000,000 spectators each year. Many college stadiums hold more than 50,000 spectators; one stadium, at the University of Michigan, has 101,001 seats.

The birth date of football in the U.S. is generally regarded by football historians as Nov. 6, 1869, when teams from Rutgers and Princeton Universities met in New Brunswick, N.J., for the first intercollegiate football game. In its early years, American football was played according to rules derived from soccer and Rugby football, principally the latter. In the early games, each team had twenty-five players. By 1873 the number was reduced to twenty, in 1876 to fifteen, and in 1880 to eleven, where it has remained fixed to the present time.

Unlike its counterpart in American sports, baseball (q.v.), the game of football has a history of constant rules changes. The field itself has been reduced in length from 120 yd., exclusive of end zones, to the current 100 yd., and in width from 100 yd. to the present 53½ yd. The ball was once completely round, then became a prolate spheroid 23 in. around the middle, and now is 21¼–21½ in. around the middle. At one time a touchdown counted two points and a field goal five. Now the touchdown is six points and a field goal three. Most of the rules changes of football have been designed for two reasons: to maintain a balance between the offense and defense, and to foster the safety of the players.

By 1906, the game was extremely rough, and many injuries and some deaths occurred. Educators considered dropping the sport despite its popularity on campuses. Then President Theodore Roosevelt (q.v.), an ardent advocate of strenuous sports, declared that the game must be made safer. The result of his edict was a parley among football leaders, who revamped the game and outlawed many of the rougher tactics.

Among the numerous revisions in the rules was the legalizing of the forward pass. It was hoped, and the hope proved correct, that by thus opening up the game fewer young men would be injured in the mass rushing plays that were so effective and popular at the turn of the



After the ball has been snapped to him by the center, the quarterback (12) hands it to a back plunging ahead on a running play.
UPI

century. The rules committee also changed the downs system, requiring a team to make 10 yd., not 5, in three tries for a first down. In 1912 the rule was expanded to four tries, or downs, to make a first down.

In the 1900's, college football became one of America's great sports spectacles. Such student athletes as Jim Thorpe (q.v.) of Carlisle Institute, George Gipp (d. 1920) of Notre Dame University, Red Grange (1903–) of the University of Illinois, Tom Harmon (1919–) of the University of Michigan, Doak Walker (1927–) of Southern Methodist University, Glenn Davis (1925–) and Doc Blanchard (1925–), the "Touchdown Twins" of Army (the United States Military Academy), and O.J. Simpson (1947–) of the University of Southern California rank among the greatest U.S. sports heroes.

After World War II, college athletes began to receive football scholarships in such increasing numbers that today virtually every major college athlete is paid his room, board, tuition, and other expenses, usually out of money taken in by the college stadium ticket offices. At the same time, the quality of the game has steadily

improved. Many of the major universities are grouped in conferences, such as the Big Ten, the Southeastern Conference, the Ivy League, and the Western Athletic Conference.

College Bowl Games. The best college teams are awarded trips to bowl games, matching them against other outstanding teams at the end of the season's competition. The tradition of bowl games was begun in 1902 at Pasadena, Calif., when a powerful Stanford team invited Michigan to come West for a New Year's Day game; this became the celebrated Rose Bowl game. Additional bowl games were instituted, and now such other yearly postseason contests as the Cotton Bowl in Dallas, Texas, the Orange Bowl in Miami, Fla., and the Sugar Bowl in New Orleans, La., are played before large stadium crowds and nationwide television audiences. The bowl games represent the climax of the college season. The records of the more important of the many annual bowl games are listed in the following tables.

POSTSEASON GAME RECORDS

Rose Bowl Pasadena, California

Year	Team	Score	Team	Score
1902	Michigan	49	Stanford	0
1916 ¹	Washington State	14	Brown	0
1917	Oregon	14	Pennsylvania	0
1920 ²	Harvard	7	Oregon	6
1921	California	28	Ohio State	0
1922	Wash. & Jefferson	0	California	0
1923	Southern California	14	Penn State	3
1924	Navy	14	Washington	14
1925	Notre Dame	27	Stanford	10
1926	Alabama	20	Washington	19
1927	Alabama	7	Stanford	7
1928	Stanford	7	Pittsburgh	6
1929	Georgia Tech	8	California	7
1930	Southern California	47	Pittsburgh	14
1931	Alabama	24	Washington State	0
1932	Southern California	21	Tulane	12
1933	Southern California	35	Pittsburgh	0
1934	Columbia	7	Stanford	0
1935	Alabama	29	Stanford	13
1936	Stanford	7	Southern Methodist	0
1937	Pittsburgh	21	Washington	0
1938	California	13	Alabama	0
1939	Southern California	7	Duke	3
1940	Southern California	14	Tennessee	0
1941	Leland Stanford	21	Nebraska	13
1942 ³	Oregon State	20	Duke	16
1943	Georgia	9	U C L A	0
1944	Southern California	29	Washington	0
1945	Southern California	25	Tennessee	0
1946	Alabama	34	Southern California	14
1947	Illinois	45	U C L A	14
1948	Michigan	49	Southern California	0
1949	Northwestern	20	California	14
1950	Ohio State	17	California	14
1951	Michigan	14	California	6
1952	Illinois	40	Stanford	7
1953	Southern California	7	Wisconsin	0
1954	Michigan State	28	U C L A	20
1955	Ohio State	20	Southern California	7
1956	Michigan State	17	U C L A	14
1957	Iowa	35	Oregon	19
1958	Ohio State	10	Oregon	7
1959	Iowa	38	California	12
1960	Washington	44	Wisconsin	8
1961	Washington	17	Minnesota	7
1962	Minnesota	21	U C L A	3
1963	Southern California	42	Wisconsin	37
1964	Illinois	17	Washington	7
1965	Michigan	34	Oregon State	7
1966	U C L A	14	Michigan State	12
1967	Purdue	14	Southern California	13
1968	Southern California	14	Indiana	3
1969	Ohio State	27	Southern California	16
1970	Southern California	10	Michigan	3
1971	Stanford	27	Ohio State	17
1972	Stanford	13	Michigan	12
1973	Southern California	42	Ohio State	17
1974	Ohio State	42	Southern California	21
1975	Southern California	18	Ohio State	17
1976	U C L A	23	Ohio State	10
1977	Southern California	14	Michigan	6
1978	Washington	27	Michigan	20

1903 through 1915 no games. ² 1918 and 1919 no game (war). ³ Played in Durham N C (war)

Sugar Bowl, New Orleans, Louisiana

Year	Team	Score	Team	Score
1935	Tulane	20	Temple	14
1936	Texas Christian	3	Louisiana State	2
1937	Santa Clara	21	Louisiana State	14
1938	Santa Clara	6	Louisiana State	0
1939	Texas Christian	15	Carnegie	7
1940	Texas A. & M.	14	Tulane	13
1941	Boston College	19	Tennessee	13
1942	Fordham	2	Missouri	0
1943	Tennessee	14	Tulsa	7
1944	Georgia Tech	20	Tulsa	18
1945	Duke	29	Alabama	26
1946	Oklahoma A. & M.	33	Saint Mary's (Calif)	13
1947	Georgia	20	North Carolina	10
1948	Texas	27	Alabama	7
1949	Oklahoma	14	North Carolina	6
1950	Oklahoma	35	Louisiana State	0
1951	Kentucky	13	Oklahoma	7
1952	Maryland	28	Tennessee	13
1953	Georgia Tech	24	Mississippi	7

Sugar Bowl—Continued

Year	Team	Score	Team	Score
1954	Georgia Tech	42	West Virginia	19
1955	Navy	21	Mississippi	0
1956	Georgia Tech	7	Pittsburgh	0
1957	Baylor	13	Tennessee	7
1958	Mississippi	39	Texas	7
1959	Louisiana State	7	Clemson	7
1960	Mississippi	21	Louisiana State	0
1961	Mississippi	14	Rice	6
1962	Alabama	10	Arkansas	3
1963	Mississippi	17	Arkansas	13
1964	Alabama	12	Mississippi	7
1965	Louisiana State	13	Syracuse	10
1966	Missouri	20	Florida	18
1967	Alabama	34	Nebraska	7
1968	Louisiana State	20	Wyoming	13
1969	Arkansas	16	Georgia	2
1970	Mississippi	27	Arkansas	22
1971	Tennessee	34	Air Force	13
1972	Oklahoma	40	Auburn	22
1973	Oklahoma	14	Penn State	0
1974	Notre Dame	24	Alabama	23
1975	Nebraska	13	Florida	10
1976	Alabama	13	Penn State	6
1977	Pittsburgh	27	Georgia	3
1978	Alabama	35	Ohio State	6

This game played Dec 31 1972 was forfeited by Oklahoma after recruiting irregularities were uncovered

Orange Bowl Miami Florida

Year	Team	Score	Team	Score
1933	Miami (Fla)	7	Manhattan	0
1934	Duquesne	33	Miami (Fla)	7
1935	Bucknell	26	Miam (Fla)	0
1936	Catholic University	20	Mississippi	19
1937	Duquesne	13	Mississippi State	12
1938	Auburn	6	Michigan State	0
1939	Tennessee	17	Oklahoma	0
1940	Georgia Tech	21	Missouri	7
1941	Mississippi State	17	Georgetown	7
1942	Georgia	40	Texas Christian	26
1943	Alabama	37	Boston College	21
1944	Louisiana State	19	Texas A. & M	14
1945	Tulsa	26	Georgia Tech	12
1946	Miami (Fla)	13	Holy Cross	6
1947	Rice	8	Tennessee	0
1948	Georgia Tech	20	Kansas	14
1949	Texas	41	Georgia	28
1950	Santa Clara	21	Kentucky	13
1951	Clemson	15	Miami (Fla.)	14
1952	Georgia Tech	17	Baylor	14
1953	Alabama	61	Syracuse	6
1954	Oklahoma	7	Maryland	0
1955	Duke	34	Nebraska	7
1956	Oklahoma	20	Maryland	6
1957	Colorado	27	Clemson	21
1958	Oklahoma	48	Duke	21
1959	Oklahoma	21	Syracuse	6
1960	Georgia	14	Missouri	0
1961	Missouri	21	Navy	14
1962	Louisiana State	25	Colorado	7
1963	Alabama	17	Oklahoma	0
1964	Nebraska	13	Auburn	7
1965	Texas	21	Alabama	17
1966	Alabama	39	Nebraska	28
1967	Florida	27	Georgia Tech	12
1968	Oklahoma	26	Tennessee	24
1969	Penn State	15	Kansas	14
1970	Penn State	10	Missouri	3
1971	Nebraska	17	Louisiana State	12
1972	Nebraska	38	Alabama	6
1973	Nebraska	40	Notre Dame	6
1974	Penn State	16	Louisiana State	19
1975	Notre Dame	13	Alabama	11
1976	Oklahoma	14	Michigan	6
1977	Ohio State	27	Colorado	10
1978	Arkansas	31	Oklahoma	6

Cotton Bowl Dallas, Texas

Year	Team	Score	Team	Score
1937	Texas Christian	16	Marquette	16
1938	Rice	28	Colorado Univ	14
1939	Saint Mary's (Calif)	20	Texas Tech	13
1940	Clemson	6	Boston College	13
1941	Texas A. & M.	13	Fordham	12
1942	Alabama	29	Texas A. & M	21
1943	Texas	14	Georgia Tech	17
1944	Randolph Field	7	Texas University	17
1945	Oklahoma A. & M.	34	Texas Christian	6

Cotton Bowl—Continued

Year	Team	Score	Team	Score
1946	Texas	40	Missouri	27
1947	Arkansas	0	Louisiana State	0
1948	Southern Methodist	13	Penn State	13
1949	Southern Methodist	21	Oregon	13
1950	Rice	27	North Carolina	13
1951	Tennessee	20	Texas	14
1952	Kentucky	20	Texas Christian	7
1953	Texas	16	Tennessee	0
1954	Rice	28	Alabama	6
1955	Georgia Tech	14	Arkansas	6
1956	Mississippi	14	Texas Christian	13
1957	Texas Christian	28	Syracuse	27
1958	Navy	20	Rice	7
1959	Texas Christian	0	Air Force Academy	0
1960	Syracuse	23	Texas	14
1961	Duke	7	Arkansas	6
1962	Texas	12	Mississippi	7
1963	Louisiana State	13	Texas	0
1964	Texas	28	Navy	6
1965	Arkansas	10	Nebraska	7
1966	Louisiana State	14	Arkansas	7
1967	Georgia	24	Southern Methodist	9
1968	Texas A & M	20	Alabama	16
1969	Texas	36	Tennessee	13
1970	Texas	21	Notre Dame	17
1971	Notre Dame	24	Texas	11
1972	Penn State	30	Texas	6
1973	Texas	17	Alabama	13
1974	Nebraska	19	Texas	3
1975	Penn State	41	Baylor	20
1976	Arkansas	31	Georgia	10
1977	Houston	30	Maryland	21
1978	Notre Dame	38	Texas	10

College National Champions The champion college team is selected by national polls. Of the following selections those from 1889 to 1923 are Helms Athletic Foundation; from 1924 to 1930 Rissman Trophy; from 1931 to 1935 Rockne Memorial Trophy; from 1936 to date Associated Press (AP) poll; and from 1950 to date United Press International (UPI) poll. In cases where two teams won the honor in separate AP and UPI polls, a note has been made. V T L

COLLEGE NATIONAL CHAMPIONS

Year	Team	Coach	Record*		
			W	L	T
1889	Princeton	(None)	10	0	0
1890	Harvard	George Stewart & George Adams	11	0	0
1891	Yale	Walter Camp	18	0	0
1892	Yale	Walter Camp	13	0	0
1893	Princeton	(None)	11	0	0
1894	Yale	William Rhodes	16	0	0
1895	Pennsylvania	George Woodruff	14	0	0
1896	Princeton	(None)	10	0	1
1897	Pennsylvania	George Woodruff	15	0	0
1898	Harvard	Cameron Forbes	11	0	0
1899	Harvard	Benjamin Dibblee	10	0	1
1900	Yale	Malcolm McBride	12	0	0
1901	Michigan	Fielding Yost	10	0	0
1902	Michigan	Fielding Yost	11	0	0
1903	Princeton	Arthur Hilebrand	11	0	0
1904	Pennsylvania	Carl Williams	12	0	0
1905	Chicago	Amos Alonzo Stagg	10	0	0
1906	Princeton	William Roper	9	0	1
1907	Yale	William Knox	9	0	1
1908	Pennsylvania	Sci Metzger	11	0	1
1909	Yale	Howard Jones	10	0	0
1910	Harvard	Percy Haughton	8	0	1
1911	Princeton	William Roper	8	0	2
1912	Harvard	Percy Haughton	9	0	0
1913	Harvard	Percy Haughton	9	0	0
1914	Army	Charles Daly	9	0	0
1915	Cornell	Albert Sharpe	9	0	0
1916	Pittsburgh	Glenn Warner	8	0	0
1917	Georgia Tech	John Heisman	9	0	0
1918	Pittsburgh	Glenn Warner	4	1	0
1919	Harvard	Robert Fisher	18	0	0
1920	California	Andy Smith	18	0	0

College National Champions—Continued

Year	Team	Coach	Record*		
			W	L	T
1921	Cornell	Gil Dobie	8	0	1
1922	Cornell	Gil Dobie	8	0	0
1923	Illinois	Bob Zupke	8	0	0
1924	Notre Dame	Knute Rockne	19	0	0
1925	Dartmouth	Jesse Hawley	8	0	0
1926	Stanford	Glenn Warner	10	0	0
1927	Illinois	Bob Zupke	7	0	1
1928	Southern California	Howard Jones	9	0	1
1929	Notre Dame	Knute Rockne	9	0	0
1930	Notre Dame	Knute Rockne	10	0	0
1931	Southern California	Howard Jones	19	1	0
1932	Michigan	Harry Kipke	8	0	0
1933	Michigan	Harry Kipke	7	0	1
1934	Minnesota	Bernie Bierman	8	0	0
1935	S M U	Matty Bell	12	10	0
1936	Minnesota	Bernie Bierman	7	1	0
1937	Pittsburgh	Jock Sutherland	9	0	1
1938	T C U	Leo (Dutch) Meyer	10	0	0
1939	Texas A. & M	Homer Norton	10	0	0
1940	Minnesota	Bernie Bierman	8	0	0
1941	Minnesota	Bernie Bierman	8	0	0
1942	Ohio State	Paul Brown	9	1	0
1943	Notre Dame	Frank Leahy	9	1	0
1944	Army	Earl (Red) Blaik	9	0	0
1945	Army	Earl (Red) Blaik	9	0	0
1946	Notre Dame	Frank Leahy	8	0	1
1947	Notre Dame	Frank Leahy	9	0	0
1948	Michigan	Bennie Oosterbaan	9	0	0
1949	Notre Dame	Frank Leahy	10	0	0
1950	Oklahoma	Bud Wilkinson	10	10	0
1951	Tennessee	Bob Neyland	10	10	0
1952	Michigan State	Biggie Munn	9	0	0
1953	Maryland	Jim Tatum	10	10	0
1954	Ohio State (AP) U C L A. (UPI)	Woody Hayes Red Sanders	19	0	0
1955	Oklahoma	Bud Wilkinson	10	0	0
1956	Oklahoma	Bud Wilkinson	10	0	0
1957	Auburn (AP) Ohio State (UPI)	Ralph (Shug) Jordan Woody Hayes	10	0	0
1958	L S U	Paul Dietzel	18	1	0
1959	Syracuse	Ben Scharfswalder	10	0	0
1960	Minnesota	Murray Warmath	8	11	0
1961	Alabama	Paul (Bear) Bryant	10	0	0
1962	Southern California	John McKay	10	0	0
1963	Texas	Darrell Royal	10	0	0
1964	Alabama	Paul (Bear) Bryant	10	10	0
1965	Alabama (AP) Michigan State (UPI)	Paul (Bear) Bryant Duffy Daugherty	18	1	1
1966	Notre Dame	Ara Parseghian	10	10	0
1967	Southern California	John McKay	9	0	1
1968	Ohio State	Woody Hayes	19	0	0
1969	Texas	Darrell Royal	10	0	0
1970	Texas	Darrell Royal	10	10	0
1971	Nebraska	Bob Devaney	12	0	0
1972	Southern California	John McKay	12	0	0
1973	Notre Dame (AP) Alabama (UPI)	Ara Parseghian Paul (Bear) Bryant	10	0	0
1974	Oklahoma (AP) Southern California (UPI)	Barry Switzer John McKay	11	10	0
1975	Oklahoma	Barry Switzer	19	1	1
1976	Pittsburgh	Johnny Majors	10	1	0
1977	Notre Dame	Dan Devine	11	0	0

* Regular season, Bowl game record indicated by win (†) loss (‡) tie (X).

FOOTBALL AMERICAN PROFESSIONAL

game of football as played in the United States by teams whose members receive financial remuneration for their services. The rules for the professional game are generally the same as those for collegiate or amateur football with some exceptions see FOOTBALL AMERICAN

History The first professional football game in the U S took place in 1895 in the town of Latrobe Pa between a team representing that

FOOTBALL, AMERICAN PROFESSIONAL

town and the team of Jeannette, Pa. In the following ten years many professional teams were formed, including the Duquesnes of Pittsburgh, the Olympics of McKeesport, Pa., the Bulldogs of Canton, Ohio, and the team of Massillon, Ohio. Among noted amateur players who took up the professional game during this decade were Willie Heston (formerly at the University of Michigan), Jim Thorpe (Carlisle Institute), Knute Rockne (Notre Dame University), and Fritz Pollard (Brown University). The professional game attracted only limited public support during its first thirty years. The first league of professional football teams was the American Professional Football Association, formed in 1920. It gave way in 1922 to the National Football League (NFL). A tremendous stimulus to public interest in the professional game was provided by the famous halfback Harold "Red" Grange (University of Illinois), who in 1925 joined the professional Chicago Bears of the National League and toured the U.S. with a professional team that year and the next. His playing drew large crowds, thereafter professional football attracted more and more first-rate college players, and the increased patronage of the public placed the game on a paying basis.

The league adopted in 1936 the so-called Draft Rule, a system which assigned graduating college stars to the various league teams in such a way that a fair distribution of talent was assured. In 1946 a second major professional football league, which was called the All-America Football Conference, began to operate in competition with the National League. In December, 1949, after a period of rivalry, the All-America Conference was absorbed into the National Football League.

The advent of national television and the vast income it provided made formation of another major league financially possible, and in 1960 the American Football League (AFL) began play. Competitive bidding for the services of outstanding college players soon imposed a heavy financial burden on both leagues. In answer to this problem, among others presented by the increasing rivalry, a merger of the two leagues was announced on June 8, 1966. The immediate result of the merger was a common draft pool of new talent. The final stage of the merger, which became effective in 1970, provided for one commissioner and one league. The league was divided into two conferences, the National Football Conference (NFC) and the American Football Conference (AFC). Playoff games between the conference winners, known as the Super Bowl, began in January, 1967. V T L

MAJOR LEAGUE PROFESSIONAL FOOTBALL CHAMPIONS

National Football League¹

Year	Team	Year	Team
1933	Chicago Bears	1950	Cleveland Browns
1934	New York Giants	1951	Los Angeles Rams
1935	Detroit Lions	1952	Detroit Lions
1936	Green Bay Packers	1953	Detroit Lions
1937	Washington Redskins	1954	Cleveland Browns
1938	New York Giants	1955	Cleveland Browns
1939	Green Bay Packers	1956	New York Giants
1940	Chicago Bears	1957	Detroit Lions
1941	Chicago Bears	1958	Baltimore Colts
1942	Washington Redskins	1959	Baltimore Colts
1943	Chicago Bears	1960	Philadelphia Eagles
1944	Green Bay Packers	1961	Green Bay Packers
1945	Cleveland Rams	1962	Green Bay Packers
1946	Chicago Bears	1963	Chicago Bears
1947	Chicago Cardinals	1964	Cleveland Browns
1948	Philadelphia Eagles	1965	Green Bay Packers
1949	Philadelphia Eagles		

¹ From 1933, when playoffs first took place, became National Football Conference, 1970.

All-America Football Conference¹

Year	Team	Year	Team
1946	Cleveland Browns	1948	Cleveland Browns
1947	Cleveland Browns	1949	Cleveland Browns

¹ Absorbed into NFL in 1950

American Football League¹

Year	Team	Year	Team
1960	Houston Oilers	1963	San Diego Chargers
1961	Houston Oilers	1964	Buffalo Bills
1962	Dallas Texans	1965	Buffalo Bills

¹ Became American Football Conference 1970

Super Bowl

1967	Green Bay Packers (NFL)	35
	Kansas City Chiefs (AFL)	10
1968	Green Bay Packers (NFL)	33
	Oakland Raiders (AFL)	14
1969	New York Jets (AFL)	16
	Baltimore Colts (NFL)	7
1970	Kansas City Chiefs (AFL)	23
	Minnesota Vikings (NFL)	7
1971	Baltimore Colts (AFC)	16
	Dallas Cowboys (NFC)	13
1972	Dallas Cowboys (NFC)	24
	Miami Dolphins (AFC)	3
1973	Miami Dolphins (AFC)	14
	Washington Redskins (NFC)	7
1974	Miami Dolphins (AFC)	24
	Minnesota Vikings (NFC)	7
1975	Pittsburgh Steelers (AFC)	16
	Minnesota Vikings (NFC)	6
1976	Pittsburgh Steelers (AFC)	21
	Dallas Cowboys (NFC)	7
1977	Oakland Raiders (AFC)	82
	Minnesota Vikings (NFC)	14
1978	Dallas Cowboys (NFC)	27
	Denver Broncos (AFC)	10

FOOTBALL, GAELIC, type of football played principally in Ireland, where it originated. Its date of origin is not known, but the game was popular in Ireland in the 16th century. At that time a team consisted of all the able-bodied men of a town or parish, the number of players on each team ranged from twenty-five to one hundred. Frequently the game started at a point midway between two towns or parishes, and ended when one team had driven the ball across a boundary line into its opponent's town or parish. The rules of the modern game were

promulgated in 1884 by the Gaelic Athletic Association; that body still controls and regulates the sport.

Fifteen men constitute a team in Gaelic football. The players may kick, punt, or punch the ball; or they may "hop" or dribble it, that is, keep bouncing it between hand and ground while advancing. Throwing or carrying the ball is not allowed. At each end of the field is a goal consisting of two vertical posts and a horizontal crossbar; behind the goal, under the crossbar, is a net. Kicking or punching the ball over the crossbar counts one point; punching or kicking it into the net counts three points. The game is popular in Ireland today and is also played in large cities in Canada and the United States, principally in New York City, which has a club that competes in Ireland's National League.

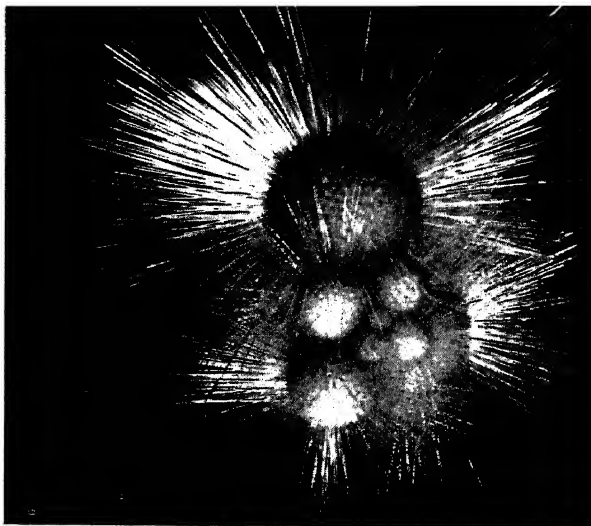
FOOTBALL, RUGBY. See RUGBY.

FOOTE, Andrew Hull (1806-63), American naval officer, born in New Haven, Conn. In 1830 he was commissioned a lieutenant in the United States Navy. In 1849 he was appointed captain of the U.S.S. *Perry* with the mission of protecting American commerce off the African coast and suppressing the slave trade. In 1856 Foote was sent to Canton, China, where he established fortified posts on shore for the protection of American residents. When these posts, flying the American flag, were fired on by Chinese forts below the city, he stormed and destroyed the forts. During the American Civil War he was placed in command of naval operations on the upper Mississippi R. Foote was an ardent temperance advocate and was instrumental in having the liquor ration abolished in the U.S. Navy in 1862.

FOOT ROT, common name for two kinds of unrelated diseases. **1.** In plant pathology, any disease causing the stem or trunk to decay in the areas near the ground. The term is often used to describe a blackening and decay of the stems of grasses, especially wheat. **2.** In veterinary medicine, a bacterial disease of the hoofs of sheep and cattle, in which the tissues around the hoof, especially between the toes, become inflamed and ulcerated. Recovery occurs when the affected tissues are pared away during the early stages of the disease. Irregular wearing of the hoof, common on very soft pastures, is a frequent cause of foot rot. See DISEASES OF ANIMALS.

FOOTWEAR. See BOOTS AND SHOES.

FORAMINIFERA, one-celled amoebalike marine creatures constituting a phylum of protozoans in the kingdom Protista (q.v.). Foraminifera extrude shells, called tests, which may be wholly organic, or mixed with sand grains, or com-



A common foraminifer, *Globigerina bulloides*
American Museum of Natural History

posed of a thin organic inner layer and a thick calcareous outer layer. Although many tests are solid, the most common type is calcareous and porous. Ranging from simple tubes to many-chambered spirals, the shells of different species may reach a diameter of 3 in. but average only $\frac{1}{50}$ in.

Foraminifera move about with slender pseudopodia, or extensions of cytoplasm, the living matter of the cell (q.v.), which stream through an opening in the test known as the aperture; in porous tests, the pseudopodia also emerge through the pores. The cytoplasm contains dark, fine granules of mitochondria (see CELL), which show a characteristic streaming as the creature moves. Larger granules found in some species are algae (q.v.). Reproduction is sexual or asexual; all the cytoplasm is used in forming the young, and the parent dies.

More than 30,000 species of foraminifera, both living and extinct, have been cataloged. The living species occur on the bottom of shallow seas or float as plankton in the upper levels of the oceans. Their food consists mainly of bacteria and diatoms (qq.v.). When the planktonic species die, their tests sink to the bottom, forming a thick deposit known as the Globigerina ooze, which is named after the abundant genus *Globigerinidae*. In past ages chalk rocks were formed by the compression of similar foraminiferal oozes, and the pyramids of Egypt were built of foraminiferal limestone capped with granite. Present-day geologists study deposits of foraminifera shells for clues to the location of petroleum.

FORBES-ROBERTSON, Sir Johnston (1853-1937), British actor-manager, born in London, England. He was educated at Charterhouse, one of England's most distinguished private schools,

FORCE

and in Rouen, France. After studying painting at the Royal Academy, he began a career on the stage in 1874 and became, in 1895, actor-manager of the Lyceum Theatre in London. Over his forty-year career he won a wide reputation for his roles in both Shakespearean and contemporary plays, achieving his greatest successes in *The Profligate* (1889) by the British dramatist Arthur Wing Pinero (q.v.) and in *The Passing of the Third Floor Back* (1908) by the British dramatist Jerome Klapka Jerome (q.v.). He made five tours of the United States between 1885 and 1915, retiring in 1916, and was knighted in 1913. His daughter Jean Forbes-Robertson (1905–) became a prominent stage actress, manager, and producer.

FORCE, in physics, strength or energy that causes or tends to cause the motion or change the momentum of a body. Whenever the motion of a body is changed, that is, whenever it is set in motion, accelerated, or changed in direction, it is under the action of a force. When a ball falls to the ground, when a wagon is pulled along the ground, or when a piece of iron is attracted to a magnet, a force has been applied. Motion and acceleration (q.v.) are always intimately related to force; see MECHANICS; NEWTON'S LAWS OF MOTION.

Two sets of units, absolute and gravitational, are used in expressing force. Absolute units are the same for all bodies in all places in the universe, and do not contain an arbitrary constant. They possess the advantage of being directly derived from the relationship between force, mass (q.v.), and acceleration. In metric units (see C.G.S. SYSTEM) the absolute unit of force is the dyne, defined as the force that will impart to a mass of 1 g an acceleration of 1 cm. per sec. each second. In English units, the equivalent of the dyne is the poundal, the force that will impart to a mass of 1 lb. an acceleration of 1 ft. per sec. each second.

Gravitational units are based on the pull exerted by the earth on a body. In metric units, the gram-force is the unit of force that the earth exerts on a mass of 1 g, or the weight of a gram mass. In English units the corresponding unit is the pound-force, the force exerted by the earth on a mass of 1 lb., or the weight of a pound mass. The weight of a mass-containing body is thus the gravitational force exerted by the earth on that body. See DYNAMICS; GRAVITATION.

FORD, American family noted for pioneering achievements in the automobile industry and for their philanthropic activities.

Henry Ford (1863–1947), automobile manufacturer, born on a farm near Dearborn, Mich., and

educated in district schools. He became a machinist's apprentice in Detroit, Mich., at the age of sixteen. From 1888 to 1899 he was a mechanical engineer, and later chief engineer, with the Edison Illuminating Company. In 1893, after several years of experimenting in his leisure hours, he completed the construction of his first automobile (q.v.), and in 1903 he founded the Ford Motor Company. Ten years later he introduced in the Ford plant the use of standardized interchangeable parts and assembly-line techniques. Although Ford neither originated nor was the first to employ such practices, he was chiefly responsible for their general adoption and for the consequent great expansion of American industry and the raising of the American standard of living.

By early 1914 this innovation, although greatly increasing productivity, had resulted in a monthly labor turnover of 40 to 60 percent in his factory, largely because of the unpleasant monotony of assembly-line work and repeated increases in the production quotas assigned to workmen. Ford met this difficulty by doubling the daily wage then standard in the industry, raising it from about \$2.50 to \$5.00. The net result was increased stability in his labor force and a substantial reduction in operating costs. These factors, coupled with the enormous increase in output that had been made possible by new technological methods, led to an increase in company profits from \$30,000,000 in 1914 to \$60,000,000 in 1916.

In 1908 the Ford company initiated production of the celebrated Model T. Until 1927, when the Model T was discontinued in favor of a more up-to-date model, the company produced and sold about 15,000,000 cars. Within the ensuing few years, however, Ford's preeminence as the largest producer and seller of automobiles in the nation was gradually lost to his competitors, largely because he was slow to adopt the practice of introducing a new model of automobile each year, which had become standard in the industry. During the 1930's Ford adopted the policy of the yearly change-over, but his company was unable to regain the position it had formerly held.

In the period from 1937 to 1941, the Ford company became the only major manufacturer of automobiles in the Detroit area that had not recognized any labor union as the collective bargaining representative of employees. At hearings before the National Labor Relations Board (q.v.), Ford was found guilty of repeated violations of the National Labor Relations Act (q.v.). The findings against him were upheld on



Henry Ford, at age 37, poses in front of the original Ford Motor Company building in Detroit, Mich. UPI

appeal to the Federal courts. Ford was constrained to negotiate a standard labor contract after a successful strike by the workmen at his main plant at River Rouge, in April, 1941.

Early in 1941 Ford was granted government contracts whereby he was, at first, to manufacture parts for bombers and, later, the airplane itself. He thereupon launched the construction of a huge plant at Willow Run, Mich., where production was begun in May, 1942. Despite certain technical difficulties, by the end of World War II in 1945 this plant had manufactured more than 8000 planes.

Ford was active in several other fields besides those of auto and airplane manufacturing. In 1915 he chartered a peace ship, which carried him and a number of like-minded individuals to Europe, where they attempted without success to persuade the belligerent governments to end World War I. He was nominated for the office of United States Senator from Michigan in 1918 but was defeated in the election. In the following year he erected the Henry Ford Hospital in Detroit at a cost of \$7,500,000. In 1919 he became the publisher of the *Dearborn Independent*, a weekly journal, that at first published anti-Semitic material. After considerable public protest Ford directed that publication of such articles be discontinued and that a public apology be made to the Jewish people.

Advancing age obliged Ford to retire from the active direction of his gigantic enterprises in 1945. Upon his death he left a personal fortune estimated at \$500,000,000 to \$700,000,000. He bequeathed the largest share of his holdings in the Ford Motor Company to the Ford Foundation (q.v.), a nonprofit organization chartered in 1936.

Edsel Bryant Ford (1893–1943), automobile manufacturer, the son of Henry, born in Detroit, Mich. In 1919 he replaced his father as president of the Ford Motor Company. He was a patron of the arts and for some years served as president of the Detroit Arts Commission. He bequeathed his personal holdings in the Ford Motor Company to the Ford Foundation.

Henry Ford II (1917–), automobile and airplane manufacturer, son of Edsel and grandson of Henry, born in Detroit, Mich., and educated at Yale University. In 1941 he joined the United States Navy with the rank of lieutenant, junior grade. Two years later, shortly after the death of his father, Henry was released from his naval duties to manage the war production of the Ford Motor Company. Ford then became executive vice-president of the company. Late in 1945, upon the retirement of his grandfather, he was elevated to the position of president, which he

FORD, FORD MADOX

held until 1960 when he became chairman and chief executive officer. In 1953 he was an alternate delegate to the United Nations General Assembly, and in 1961 he was appointed to the President's Advisory Committee on Labor-Management Policy. He became chairman of the National Alliance of Businessmen in 1968, and in the following year he was awarded the Medal of Freedom. In 1970 he was appointed to the post of chairman of the National Center for Voluntary Action.

FORD, Ford Madox (1873–1939), British writer of German descent, born Ford Madox Hueffer in Merton, England. In an effort to experience the hardships of the struggle for existence, he worked for thirteen years on a farm. During this period he was an associate of the writers Joseph Conrad (q.v.) and Henry James (see under JAMES). While serving with the British army in World War I, Ford suffered temporary amnesia as a result of the effects of poison gas. With Conrad he wrote the novels *The Inheritors* (1901) and *Romance* (1903). Ford's other novels include *Some Do Not* (1924), *No More Parades* (1925), *A Man Could Stand Up* (1926), and *The Last Post* (1928), which were posthumously republished in one volume entitled *Parade's End* (1950). His other writings include *Collected Poems* (1914); the critical study *Henry James* (1913); the biography *Joseph Conrad* (1924); and *The English Novel* (1930), which is a critical work.

FORD, Gerald R(udolph) (1913–), Thirty-eighth President of the United States, born Leslie Lynch King, Jr., in Omaha, Nebr. His divorced mother remarried when he was two years old, and he was adopted by and took the name of his stepfather. He was educated at the University of Michigan and Yale University Law School, and in 1941 he began the private practice of law in Grand Rapids, Mich. On active duty in the United States Navy from 1942 until 1946, he was discharged with the rank of lieutenant commander.

In 1948 he was elected to the United States House of Representatives from the Fifth Congressional District of Michigan as a member of the Republican Party. In 1965 he was named minority leader of the House of Representatives. In October, 1973, President Richard M. Nixon (q.v.) nominated Ford to succeed Spiro Theodore Agnew (q.v.), who had resigned from the position of Vice-President of the United States; the nomination was the first under the Twenty-fifth Amendment to the Constitution of the United States (q.v.). His nomination was confirmed by a majority vote of both houses of



President Gerald R. Ford in 1974

The White House

Congress, and Ford was sworn in as the fortieth Vice-President on Dec. 6, 1973.

In the months that followed, the Vice-President spoke frequently in support of President Nixon. As a result of various investigations into the conduct of the campaign for his reelection in 1972, the President had come under constantly increasing pressure to resign, and the House of Representatives had voted three articles of impeachment (q.v.) against him; see WATERGATE. Finally, faced with a lack of legislative and public support, President Nixon resigned, effective at noon on Aug. 9, 1974. Gerald R. Ford, the first man to serve as President who had not been elected by the American people, was then sworn in. In a brief address after the ceremony, President Ford declared "our long national nightmare is over" and "we must go forward now together".

The first crisis of Ford's Presidency occurred one month after his succession. On September 8 he granted former President Nixon an unconditional pardon for all violations of Federal law that he might have committed during his years in the White House. Public opinion was heavily against the pardon, and allegations of an agreement between the two men regarding Ford's succession were fully denied by the President on October 17, when he made an unprecedented appearance before a Congressional committee (the subcommittee on criminal jus-

tice of the Judiciary Committee of the House of Representatives).

In December, 1974, Ford's nominee for Vice-President, Nelson A. Rockefeller, was confirmed by Congress. During 1975-76 Ford pursued economic programs that lowered the nation's high rate of inflation. A large number of workers remained unemployed, however. In foreign affairs the President negotiated a preliminary arms-control agreement with the U.S.S.R. in late 1974, and on May 7, 1975, after South Vietnam had been captured by insurgents, he issued an official proclamation ending the "Vietnam era".

In July, 1975, Ford announced his intention to run for the Presidency in 1976. While on semi-political tours of California in September, he escaped unharmed from two assassination attempts. Ford won the Republican Presidential nomination in August, 1976, but he was narrowly defeated by the Democratic candidate, Jimmy Carter (q.v.), in the general election in November. After leaving office in January, 1977, Ford settled in Palm Springs, Calif., and lectured at several universities.

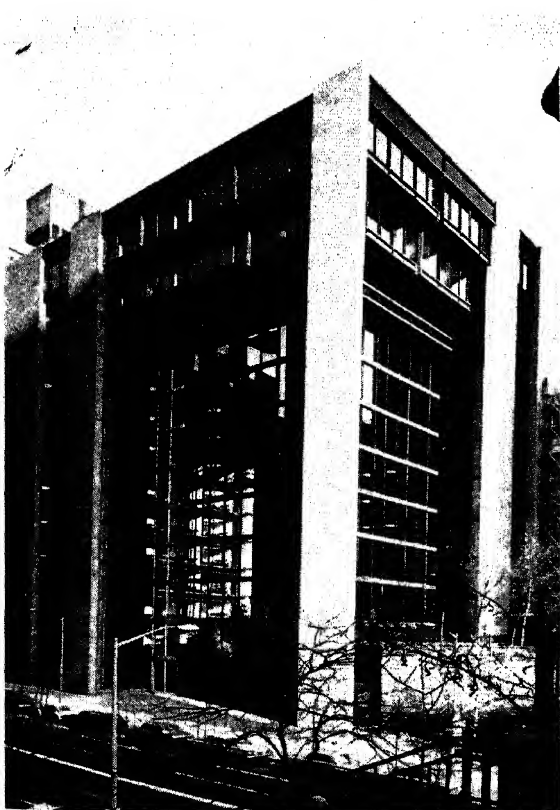
FORD, John (1586?-after 1638), English dramatist, born in Ilington, Devonshire, and educated

at Exeter College. He began his literary career as a poet, writing *Fame's Memorial* (1606), an elegy on the death of Charles Blount, Earl of Devonshire (1563-1606), and several poems commemorating court events. Turning to the drama, he collaborated with the British dramatist Thomas Dekker (q.v.) in writing *The Fairy Knight* and *The Bristowe Merchant*, about 1634. For his later plays Ford was considered by many a playwright of the first rank. Among his works are *'Tis Pity She's a Whore* (1633), *Perkin Warbeck* (1634), and *The Witch of Edmonton*, which he wrote in 1658 in collaboration with Dekker and the English actor and dramatist William Rowley (1585?-1642?).

FORD, John, professional name of SEAN O'FEENY, original name SEAN ALOYSIUS O'FEARNA (1895-1973), American motion-picture director, born in Cape Elizabeth, Maine, and educated at the University of Maine. He entered the film industry as a property man in 1914 and subsequently directed more than eighty motion pictures. Several of his films, by virtue of uncompromising realism, subtle psychological insight, and straightforward treatment of controversial themes, are highly regarded by motion-picture critics and historians. Ford was repeatedly the recipient of critical awards; the pictures for which he received the best-director award of the Academy of Motion Picture Arts and Sciences are *The Informer* (1935), *The Grapes of Wrath* (1940), *How Green Was My Valley* (1941), and *The Quiet Man* (1952). During World War II Ford served with the United States Navy and produced the documentary film *The Battle of Midway* (1942), which he photographed while under fire. His other films include *The Lost Patrol* (1934), *Stagecoach* (1939), *The Long Voyage Home* (1940), *The Fugitive* (1947), *Fort Apache* (1948), *Rio Grande* (1950), *Mogambo* (1953), *How the West Was Won* (1963), and *Seven Women* (1966).

FORD FOUNDATION, THE, American philanthropic organization, founded in 1936 by the American automobile manufacturers Henry Ford and his son Edsel Bryant Ford (see under FORD). The charter of the foundation states that it was established "for scientific, educational, and charitable purposes, all for the public welfare". Among its main objectives are: (1) to help provide equality of opportunity for all Americans in employment, education, and housing; (2) improve the educational process; (3) achieve reforms in the administration of justice and legal education; (4) help develop noncommercial television as a means of improving the quality of American life; (5) develop resources in the

The activities of the Ford Foundation are directed from its headquarters on 42nd Street in New York City.



Esto — Ford Foundation

FORDHAM UNIVERSITY

humanities and the arts; (6) aid research on problems arising from the rapid, worldwide population expansion; (7) encourage international communication and cooperation; and (8) assist the development of the poorer countries of the world.

In 1951–52, the Ford Foundation founded several independent agencies for the advancement of various phases of its program, notably the Fund for Adult Education and the Fund for the Republic. In 1955 the foundation granted \$500,000,000, the largest single philanthropic gift ever made, to about 4150 privately supported colleges, universities, medical schools, and hospitals.

In 1956 the foundation sold 10,200,000 shares of Ford Motor Company stock to the general public, receiving \$642,600,000 in payment.

Between 1958 and 1968, funds distributed to help realize the foundation's objectives included \$350,000,000 for the improvement of selected private colleges and universities; some \$28,000,000 to predominantly Negro colleges in the South; more than \$120,000,000 to encourage the integration of international-area studies into graduate programs at American universities; \$80,200,000 for a matching-grant program to launch comprehensive educational and community-development programs in backward urban areas; \$170,000,000 in assistance to non-commercial television, and some \$100,000,000 for efforts in the field of population research.

At the end of its 1974 fiscal year the foundation's total assets were \$1,830,077,000. Grants and commitments that year amounted to \$194,200,000. Foundation headquarters are located in New York City; regional offices are maintained in sixteen foreign countries. *See also* FOUNDATION.

FORDHAM UNIVERSITY, privately controlled institution of higher learning, situated in New York City. The school was founded in 1841 as Saint John's College by the Roman Catholic diocese of New York on an 80-acre farm in what was, at that time, the village of Fordham. The Society of Jesus (*see* JESUITS) was invited to administer the college in 1846, and, in the same year, the institution was made a university with the power to grant all university degrees. Between 1846 and 1860 the society purchased the buildings and part of the grounds. The name of the institution was changed to Fordham University in 1907. In 1968 the university became independent of the Society of Jesus; it is now governed by a self-perpetuating board of trustees, a majority of whom are laymen. Of the eleven colleges and schools constituting the university,

six are at the Rose Hill campus in the Bronx. These include Fordham College (for men), Thomas More College (for women), the graduate school of arts and sciences, and the college of business administration. The graduate schools of education, law, social service, and business administration and a liberal arts college are at the mid-Manhattan campus adjoining the Lincoln Center for the Performing Arts. The university libraries house some 1,000,000 volumes. In 1972–73 student enrollment was 13,898, the faculty numbered 805, and the endowment of the university was \$10,100,000.

FORD'S THEATRE NATIONAL HISTORIC SITE, theater in Washington, D.C., in which President Abraham Lincoln (q.v.) was assassinated on April 14, 1865, by the actor John Wilkes Booth (*see under* BOOTH). The building was purchased in 1866 by the United States government and in 1932 was converted into a museum containing a notable collection of Lincoln relics. In 1968 the theater, restored to look as it had on the night of Lincoln's assassination, was opened for public performances of plays. In 1970 the theater and the house in which Lincoln died were designated as Ford's Theatre National Historic Site. The site, covering .18 acres, is administered by the National Park Service (q.v.).

FORECLOSURE, legal process, whereby the right or equity of redemption of a mortgagor is cut off and the mortgagee's title to the mortgaged lands or goods is perfected; *see* MORTGAGE. The process is effected when the mortgagor fails to make payment of the debt at the proper time, or fails to meet other obligations specified in the bond or mortgage. To effect a foreclosure, it is usual to apply to a court for authority to sell the property or, particularly in the case of chattel mortgages, to proceed with sale under a power provided in the mortgage itself. In such instances the term "foreclosure" is loosely applied to the sale by the mortgagee or by a trustee on his behalf. The mortgagee is entitled to receive any balance which may remain after the expenses of the foreclosure have been met and after all prior encumbrances on the estate have been paid off.

FOREIGN EXCHANGE, currency and money claims, such as bank balances and bank drafts, expressed in the equivalent value in foreign money. Thus, a pound sterling note is money in Great Britain but is foreign exchange in the United States. A deposit of \$1000 in an American bank to the account of a French company constitutes that amount of foreign exchange in France. The term "foreign exchange" is also used to refer to transactions involving the conversion

of money of one country into that of another, or to the international transfer of money and credit instruments.

The use of foreign exchange arises from the fact that different nations have different monetary units, and the currency of one country cannot be used for making payments in another country. Because of trade, travel, and other transactions between individuals and business enterprises of different countries, it becomes necessary to convert money into currency of other countries in order to pay for goods or services in those countries. The transfer of money values from one country to another and the determination of the price at which the currency of one country will be surrendered for that of another constitute the main problems of foreign exchange.

Price Fluctuation. Foreign exchange is a commodity, and its price fluctuates in accordance with supply and demand (q.v.); exchange rates are published daily in the principal newspapers of the world. By international agreement fixed exchange rates with a narrow margin of fluctuation existed until 1973, when floating rates were adopted which fluctuate as supply and demand dictate. Foreigners need dollar exchange to pay for goods imported from the U.S., for services supplied by Americans, for interest and dividends earned by American capital invested abroad, for the purchase of securities in the U.S., and for many other types of transactions. Americans buy foreign exchange for similar reasons. The payments for services which must be made by one country to another include freight charges, insurance premiums, commissions, and travel expenses.

New York City merchants importing goods from Great Britain buy drafts on London from their banks. These drafts, or bills of exchange, create a supply of dollars and a demand for pounds. At the same time, other American merchants sell goods to persons in Great Britain and receive drafts payable in pounds which they desire to convert into dollars. The foreign-exchange banker buys the pounds from the American exporters and sells them to the importers who need pounds in exchange for their dollars.

Ordinarily, and in the absence of government restrictions, the rate of exchange, or the price of the currency of one country in terms of that of another, will depend on overall supply and demand conditions and on the relative purchasing power of the two currencies, that is, on the competitive position of the two countries in world markets. Gold and wealth tend to flow away from countries that are forced to buy more

than they sell abroad. For example, before World War II, the pound sterling was worth \$4.86, which meant the pound bought nearly five times as much in London as the dollar in New York. After the war, because of the unprecedented destruction of wealth, the pound was devalued to \$2.80. In 1968 it was devalued to \$2.40; it remained at this rate until 1971, when a major currency realignment revalued it to \$2.60. In June, 1972, the pound was allowed to float, and it subsequently settled around \$2.42. In December, 1971, and again in 1973 the U.S. dollar was devalued from \$35 to \$38 and to \$42.22, respectively, for an ounce of gold, because of the increasing imbalance in U.S. international payments; see GOLD STANDARD. Since 1973 major currencies have fluctuated in importance, but those of West Germany, Switzerland, and Japan have remained fairly strong.

At times, speculation in foreign exchange by dealers, brokers, or others becomes an important factor influencing exchange rates, because it creates an artificial demand for or supply of certain currencies.

Formerly, when many countries were on the gold standard and permitted the free flow of gold out of the country, the value of their currencies in terms of other currencies could fluctuate within only a very narrow range. The deviation from the par value, that is, the value representing the metallic content of the monetary unit, could not be more than the cost of shipping gold. As soon as the rate of exchange reached a point equivalent to the par value plus the expenses of shipping gold, it became more profitable to send gold abroad than to buy foreign currency at a higher price. Because the free export of gold has been made subject to many restrictions, the stabilizing influence of gold movements has been significantly reduced.

Government Control. When foreign-exchange needs of a country exceed total receipts from abroad, and it has little gold and is unable to receive foreign credits, the exchange value of the currency of the country tends to decline. Under these conditions, the government has the alternative of allowing freedom of transactions in foreign exchange and permitting its currency to depreciate, or of abandoning free transfer of currency by the establishment of exchange control. The aim of such control is to limit the demand for and to increase the supply of foreign exchange in order to maintain a stable exchange rate. Control usually provides for allocating foreign exchange only for approved imports, and requires that all or a part of the foreign exchange derived from exports or other sources

FOREIGN LEGION

be given to the central bank in exchange for local currency. Since the worldwide depression of the early 1930's, many countries have periodically instituted foreign-exchange controls, particularly the developing countries with limited exchange reserves. To help resolve the unbalanced international payments situation after World War II, the United Nations established in 1946 the International Monetary Fund and the International Bank for Reconstruction and Development (q.v.). The fund promotes currency stability and the removal of foreign-exchange restrictions by granting member countries foreign-exchange loans to cover temporary deficits in their international accounts. The bank grants long-term foreign-currency loans to member countries for specific projects.

The unexpected changes that took place in the world market in the 1970's, such as the quadrupling of the price of oil, altered the roles that major currencies play as foreign-exchange reserve units for most trading countries. The U.S. dollar, in particular, has been considered a weakened currency in international markets and therefore placed under international exchange controls. See DEVALUATION; EXPORT-IMPORT BANK OF THE UNITED STATES; FOREIGN TRADE.

FOREIGN LEGION (Fr. *Légion étrangère*), unit of the French army consisting of volunteers of other nationalities. Frenchmen are legally barred from joining the legion as enlisted men. Most of the officers, however, are French. The legion was established in 1831, during the reign of King Louis Philippe (q.v.), as a regiment trained for service in Algeria. The primary function of this unit is to preserve order in the French overseas possessions, but it may be sent wherever French forces are needed. The headquarters of the legion were in Sidi-bel-Abbès, Algeria, for 120 years. In 1964, however, the independent Algerian government demanded its withdrawal. Headquarters are now located in Aubagne, France.

Nationals of any country other than France may enlist if they are between the ages of eighteen and forty and are physically qualified. Backgrounds and personal histories are not investigated, and except for minors, no identification papers are required. Known war criminals, murderers, and deserters from the armed forces of allies of France, however, are rejected. A legionnaire enlists for an initial term of five years, at the end of which time he is eligible for French citizenship. Once citizenship is obtained, the legionnaire may qualify for a commission if he meets the educational requirements for officers.

After service in Algeria the legion took part in

colonial campaigns in many French colonies, especially in north Africa and Indochina. It fought in the Crimean War (1854–56), in Italy against the Austrians (1859), in Mexico in support of Emperor Maximilian (q.v.), and in the Franco-German War (q.v.). During World War I it served with distinction on many fronts and was the most decorated unit of the French army. The legion fought in Norway and in France at the beginning of World War II. After the fall of France in 1940 many legionnaires joined the Free French (q.v.) forces of General Charles de Gaulle (q.v.). Their heroic defense of Bir Hakeim in Libya in 1942 brought the legion new honors. Reorganized after World War II, the legion subsequently saw active service in Indochina, Korea, and north Africa. Large numbers of German war veterans enlisted in the legion immediately after World War II. In 1946, however, the maximum number of German legionnaires was fixed at 25 percent of the total strength. Current strength of the legion is about 12,000 men, stationed mainly in the Malagasy Republic and the Territory of the Afars and Issas. A small force is also maintained in northern Africa.

FOREIGN SERVICE OF THE UNITED STATES, segment of the United States Department of State that aids in maintaining peaceful cordial relations between the United States and other nations. The Foreign Service was established by Congress in 1924 by combining diplomatic personnel concerned primarily with governmental relations and consular personnel concerned largely with individual and commercial matters. The Foreign Service is responsible for gathering information conducive to the formation of American foreign policy, for implementing foreign policy abroad, and for safeguarding U.S. citizens and their personal and commercial interests in other lands. The Foreign Service maintains embassies, legations, missions, consulates general, consulates, and consular agencies throughout the world. See DIPLOMACY; EXTRATERRITORIALITY.

Organization. The personnel of the Foreign Service is divided into three groups. The Foreign Service Officer Corps, composed of the chief U.S. diplomatic and consular personnel abroad, includes ambassadors; ministers; counselors of embassy; attachés for science, labor, commerce, and agriculture; first, second, and third secretaries; and consuls general, consuls and vice-consuls. The Foreign Service Reserve Corps consists of various specialists, such as scientists or engineers, briefly employed. The Foreign Service Staff comprises both clerical and technical employees.

Applicants to the Foreign Service Officer Corps must be American citizens. They must pass written, oral, security, and physical examinations and be confirmed in their appointment by the United States Senate.

History. Article II, Section 2 of the Constitution of the United States (q.v.), allows the President with the advice and consent of the Senate to appoint ambassadors. The foreign diplomatic service of the nations, however, actually originated even earlier, during the American Revolutionary period, when emissaries from the Continental Congress (q.v.) traveled abroad seeking assistance for the colonies' struggle for independence against Great Britain. During the early years of the new republic, leading statesmen, among them Benjamin Franklin, John Jay, Thomas Jefferson, and John Quincy Adams (qq.v.), usually served as foreign ministers. In 1792 Congress created a consular service, the early duties of which were largely confined to matters of shipping. Through the century that followed, these posts, and diplomatic positions as well, came to be filled as a form of political patronage, sometimes by incompetent men.

As relations between the U.S. and other nations expanded in scope and complexity, the need for a trained corps of skilled and capable diplomats became increasingly apparent. In 1856 Congress regulated diplomatic salaries and classified consular posts; diplomats filling the more important consular positions were forbidden to engage in private trade. In 1895 President Grover Cleveland (q.v.) put the consular service on a limited merit basis. For the first time, appointees had to demonstrate their fitness for diplomatic work by previous service in the Department of State or by passing a qualifying examination. The professionalization of the Foreign Service proceeded through the adoption of merit examinations and changes in tenure and promotion policies. Salaries were raised, and allowances while serving abroad, for example, the representation allowance designated for entertainment expenses, were increased.

In 1906 Congress, by law, and President Theodore Roosevelt (q.v.), by executive order, regularized and extended the merit system instituted by Cleveland. In 1909 President William Howard Taft (q.v.) decreed the same system for diplomats in the foreign service below the rank of minister. President Taft also initiated a rating system on which promotion was based; in 1915 Congress made the Taft decree a law.

The most important step toward professionalization of the Foreign Service occurred in 1924 with the passage of the Rogers Act, creating the

present-day Foreign Service. The Rogers Act merged the diplomatic and consular services under the same terms of appointment by merit examination and promotion by rating. The Foreign Service Act of 1946 and later amendments further reorganized the service. In 1946, also, the Foreign Service Institute was created to give continuous on-the-job training to Foreign Service officers.

FOREIGN TRADE or **INTERNATIONAL TRADE**, term applied to commerce between nations, and particularly to business transactions among countries. Many essential services and functions, performed by business enterprises, are closely associated with foreign trade, such as transportation, insurance (qq.v.), banking and financing, communications, and forwarding; see **BANKS AND BANKING**.

The commodities exchanged on the world market are limited to those with international demand and supply, and comprise two broad groups, raw materials and finished and semi-finished manufactures. The principal raw materials in foreign trade are foodstuffs; nonfood agricultural products, such as rubber, lumber, hemp, and oilseeds; and minerals, chiefly metallic ores and mineral fuels. The exchange of some manufactures for others is rising, as well as for foodstuffs and industrial raw materials. A product is not traded internationally if the cost of transportation is prohibitive, or if there is a large demand for it in its country of origin.

World trade once meant an interchange between the tropical belt and the temperate zones on either side, but this has changed with the advance of industrialization. In recent years about 75 percent (by value) of the exports of the world, excluding those of the Soviet Union and the Communist bloc of states, were products of the Western European industrial countries, the United States, Canada, and Japan. The exports of undeveloped countries, particularly those in tropical regions, accounted for about 25 percent of the total trade.

Statistics of world trade were meager until the League of Nations and the United Nations (qq.v.) began to collect data from member countries. The dollar value of world trade, including both exports and imports, but excluding the trade of the Soviet Union and Communist-bloc countries of Europe and Asia, dropped from \$68.9 billion in 1929 to \$43.9 billion in 1938, reflecting the prevailing economic crisis. After World War II (q.v.) it rose from \$121.1 billion in 1948 to an estimated \$2.04 trillion in the mid-1970's. The increase in trade was of the greatest benefit to the industrialized countries,

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including those of North America and Western Europe as well as Japan, which controlled about three fourths of trade (by value). The growth of exports among the developing countries centered around raw materials, primarily oil exports from the Middle East, Venezuela, Indonesia, and Nigeria. Their oil revenues expanded vastly after 1973. Since the 1960's trade between the Communist and non-Communist nations has increased.

Advantages of Foreign Trade. Among the advantages of foreign trade are the enlargement of markets and the opportunities to specialize in production, overcome domestic deficiencies, and support large populations. In industrial nations production costs are lowered and employment rises as a result of expanded export markets. Although the foreign trade of some industrial nations is small compared to their domestic commerce, the economic viability of many countries depends upon the sale of goods in foreign markets. Foreign trade integrates countries producing agricultural products and raw materials into the world economy; integration in turn makes possible the exploitation of productive resources with capital invested by industrial countries, as well as the raising of industrial skills and of the standard of living, and, eventually, economic independence.

Specialization in production is the principal advantage of foreign trade, according to the 18th-century Scottish economist Adam Smith (q.v.) and many modern economists. Most countries produce and export commodities that can be produced cheaply and efficiently, according to the natural resources or industrial facilities available. The wealth of a nation is increased by the volume and quality of goods obtained from the widest possible market, rather than by money payments for its exports.

Deficiencies in domestic resources may be overcome by the importation of goods that cannot be produced at home. No nation, however well endowed, is wholly self-sufficient; despite its wealth of resources, the U.S. has to import many essential products, particularly natural rubber, tin, chrome, antimony, graphite, sugar, coffee, tea, and energy resources.

Foreign trade provides the means of existence for certain nations. A poorly endowed country with a vast population, such as Japan, supports its people by importing food and industrial raw materials and by exporting manufactures; Great Britain became the world's leading commercial power in the 19th century in this way. Other advantages of foreign trade are the rise in national income resulting from increased production for

export, and the possibility of overcoming depressed domestic business conditions by trading with prosperous countries. When foreign orders are reduced because of a business decline abroad, production cutbacks may generate a recession in the economy of the exporting country.

Restrictions on Foreign Trade. It is essential to foreign trade that trading nations maintain an over-all balance of payments between exports and imports. At the beginning of the mercantile era (see **MERCANTILE SYSTEM**) governments sought a favorable balance of trade, that is, an excess of exports over imports, as a prerequisite for national power, and heedless of payments requirements began to regulate their foreign trade to this end. Thereafter nationalistic rather than economic considerations often dominated foreign-trade policies, and increasing restrictions were placed on the movement of goods across political frontiers.

Foreign trade restrictions began with the impositions of tariffs on imports, a system that was also used to raise revenue and protect infant industries (see **FREE TRADE AND PROTECTION**). Tariffs are barriers to the efficient flow of trade, and frequently divert commerce from low-cost to high-cost centers of production. They were the principal obstruction to world trade until World War I. Tariffs were comparatively high in some countries, such as the U.S., and comparatively low in others, such as Great Britain. See **TARIFF**.

Nontariff trade restrictions or barriers include administrative regulations, laws that enforce purity and sanitation standards and technical specifications, import prohibitions, and anti-dumping duties.

Since World War I (q.v.), and notably since World War II, restrictions known as quantitative controls of imports and exports have been introduced. They control import and export quotas as well as foreign exchange (q.v.), and in some cases complete prohibition of certain commodities. The purpose of quantitative controls in the 1930's was to protect the countries imposing them from drains on the domestic supply of gold and foreign money caused by an unusually heavy excess of imports. In some cases, however, the controls protect domestic producers whose prices are higher than those of the free international market. This prevents exportation of scarce strategic materials, fosters domestic production, and prevents certain materials from falling into the possession of enemy nations. See **EMBARGO**.

Other restrictive measures on foreign trade are export subsidies and blocked accounts.

These are accounts in which money received for imported goods must be spent in the country that imports them. Although the economic position of a country may require these measures, the result interferes with the free movement of world trade.

Many countries, particularly those producing essential raw materials and foodstuffs, have long suffered from chronic surplus supplies, that is, supplies of their principal products in excess of the amount that can be sold on the world market. Between World War I and World War II this condition was aggravated, especially during the depression years of the early 1930's. Countries so affected took steps to reduce their chronic surplus by restricting production, distribution, and export of accumulated commodities. Private producers and cartels sometimes adopted these policies (see *MONOPOLY AND COMPETITION*), occasionally in cooperation with governments, or under the supervision of the League of Nations. The stated objective of these policies, the maintenance of reasonably stable and profitable prices, was seldom attained, but they gravely hampered the world exchange of commodities.

To moderate the many restrictions on foreign trade, as well as to increase the volume of trade, a number of measures went into effect after 1930. They were initiated by a single government, by several governments acting jointly, or under international auspices. The U.S. took the initiative in relaxing foreign-trade restrictions by negotiating (1934) bilateral agreements with other countries, providing for reciprocal reduction of tariffs and other trade barriers. Such reciprocal trade agreements have since been renewed; see *TARIFFS, UNITED STATES*. In a further move to promote foreign trade the U.S. government organized (1934) the Export-Import Bank of Washington (q.v.).

Foreign Trade after World War II. The revival of foreign trade after World War II was stimulated by the massive economic-aid programs extended by creditor nations, particularly the U.S., to debtor nations. The Marshall Plan, or European Recovery Program (q.v.), was the first U.S. effort; it furnished aid to sixteen countries of Western Europe between 1949 and 1951. Other U.S. programs helped countries in the Middle East, Africa, Asia, Latin America, and three countries in Eastern Europe, through grants, for which no repayment was expected, and with credits, which carry specific obligations to repay. Total U.S. aid from 1945 to 1972 was about \$125,000,000,000. The aid programs are partly accountable for the increase (1950-52 to 1967) of 200 percent in the international trade of

the world, excluding the Soviet Union and the Communist bloc of nations, as well as for certain postwar changes in favor of trade among countries. The Communist bloc in recent years has extended economic aid to neutral nations in Asia, Europe, the Middle East, and Africa mainly by loans carrying lower interest rates than U.S. credits and permitting repayment in part in national currencies or by barter.

The U.S. became the world's leading commercial power after World War I. The development of U.S. foreign trade since 1800 is shown in the accompanying table. Since World War II, Europe has lost while North America has gained ground as major market areas for U.S. goods. Principal U.S. export markets from 1949 to 1974 were, in descending order, Western Europe, Asia, Canada, other Western Hemisphere countries, Africa, Australia and Oceania, and the Communist bloc. Principal sources of U.S. imports during the same period were, in descending order, Western Europe, Canada, Asia, other Western Hemisphere countries, Africa, and Australia and Oceania.

VALUE OF EXPORTS FROM AND IMPORTS INTO THE UNITED STATES¹

Year	Total trade	Exports from U.S.A.	Imports into U.S.A.	Excess of exports (+) or Excess of imports (-)
1800	162	71	91	-20
1850	318	144	174	-30
1880	1,504	836	668	+168
1900	2,244	1,394	850	+544
1920	13,506	8,228	5,278	+2,950
1930	6,904	3,843	3,061	+782
1935	4,330	2,283	2,047	+235
1940	6,647	4,021	2,625	+1,396
1945	13,965	9,806	4,159	+5,646
1947	20,186	14,430	5,756	+8,673
1953	26,647	15,774	10,873	+4,900
1965	48,712	27,346	21,366	+5,980
1970	83,189	43,226	39,963	+3,263
1971	88,214	42,768	45,446	-2,698
1972	104,450	48,769	55,681	-6,912
1974	198,880	97,910	100,970	-3,070

¹ In millions of dollars.

Trading Communities. Intergovernmental action to relax restrictions and increase trade results occasionally in a customs union (q.v.) and the organization of trading communities among countries that are associated politically or geographically. In the customs union known as Benelux (q.v.), which is composed of Belgium, the Netherlands, and Luxembourg and has been operative since 1948, customs duties on trade among the member states were abolished and uniform duties were established on trade originating in nonmember states.

Trading communities, organized by politically associated countries, and aimed at easing trade restrictions and accelerating the movement of goods among members, were established by the Commonwealth of Nations (q.v.) under the Ot-

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tawa agreements of 1932 and by the Communist bloc of states in the mid-1950's. The Ottawa agreements organized a system of imperial preference which gave the Commonwealth members certain exclusive advantages in the British market, and in return gave Great Britain certain exclusive concessions in those markets. Tariffs were raised against goods originating outside the Commonwealth. The Communist trading community, the Council for Mutual Economic Assistance (q.v.), or COMECON, was organized as a counterpart to the trade groups of non-Communist countries. Communist nations that are not members of COMECON tend to trade predominantly with the COMECON countries because foreign trade is a state monopoly in Communist countries and the interchange of commodities and services is effected by barter. The Communist trading community competes with the U.S. and the industrialized non-Communist countries for trade relations with non-aligned countries in Africa, Asia, and the Middle East. Individual Communist countries trade bilaterally with Western countries, especially since the 1960's.

The European Coal and Steel Community (q.v.) was formed (1952) by France, West Germany, Italy, Belgium, the Netherlands, and Luxembourg for the purpose of controlling prices, production, and distribution of coal and steel. These six nations established the European Economic Community (q.v.), or Common Market, which became operative on Jan. 1, 1958. Customs duties and taxes equivalent to customs duties were abolished in trade among the member states during a twelve- to fifteen-year transitional period. Free movement of workers was also achieved within the Common Market during the transitional period, and the former colonial territories of member states were associated with the Common Market through mutual reduction of tariffs. In order not to be excluded from the Western European market, which accounted for 31 percent of total world trade in 1956, Great Britain proposed that the Common Market be enlarged into a seventeen-nation free-trade area, but the proposal was not accepted. On the initiative of Great Britain, the European Free Trade Association (q.v.), or E.F.T.A., was formed, including also Norway, Sweden, Denmark, Austria, Switzerland, Portugal, and, later, Ireland. Application for membership in the Common Market by Great Britain and other E.F.T.A. members was refused in 1961 and 1967. On Jan. 1, 1973, however, Great Britain, Denmark, and Ireland became members under provisions of a 1972 treaty.

The organization of the trading communities has been fairly successful in relaxing trade restrictions and increasing foreign trade among the member nations, but trade between the communities and outside countries is still hampered by tariff barriers, import quotas, and other trade restrictions. Action instituted under international auspices to reduce restrictions and to increase foreign trade began in 1947 with the General Agreement on Tariffs and Trade (q.v.), which covers four fifths of world international commerce. This agreement has eased the exchange of goods by means of multilateral trade negotiations. In 1967 negotiations, known as the Kennedy Round, achieved a 35 percent reduction in tariffs applicable to about \$40 billion of world trade in industrial products. Tariff concessions on agricultural products were also agreed upon; a world marketing arrangement for grains was later adopted, followed by a cotton textile agreement. In 1973 other negotiations were begun to further reduce trade barriers, with the goal of duty-free trade by 1990, but in the late 1970's protectionism appeared to be even more widespread. *See also* COMMERCE; COMMERCIAL TREATIES.

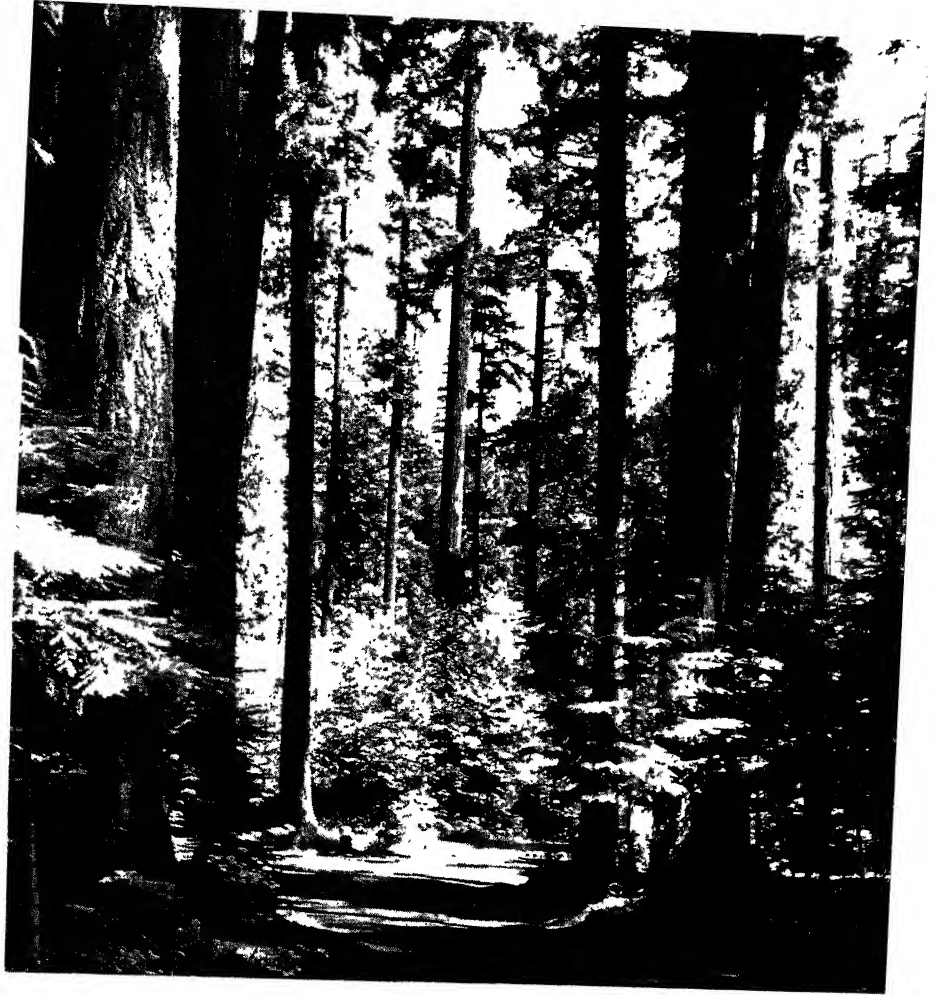
B.J.C.

FORENSIC MEDICINE. *See* MEDICAL JURISPRUDENCE.

FOREST, plant association, predominantly of trees or other woody vegetation, occupying an extensive area of land; *see* TREE. In its natural state a forest remains in a relatively fixed, self-regulated condition over a long period of time. Climatic factors, the nature of the soil, and the topography of the region determine the characteristic trees of a forest. In particular environments, dominant species of trees are characteristically associated with certain shrubs and herbs. The composition of vegetation of the forest floor is influenced by the larger plants and, because of its action on the organic composition of the soil, has a corresponding reaction on the forest; *see* ECOLOGY. Disturbances such as forest fires (q.v.) and timber harvesting may result in a shift to another forest type; *see* LUMBER INDUSTRY. Left undisturbed, ecological succession will eventually result in a so-called climax forest association that may or may not be considered desirable. Disturbances are necessary in order to maintain some desirable forest types.

Forests may be divided into eight general types on the basis of leaf characteristics and climate. (1) Deciduous forests of the temperate regions, the typical formation of E. United States. Two subtypes exist; forests of the same latitude in the Northern and Southern hemispheres are radically different, probably due to the conti-

Temperate coniferous forests. Right: Douglas firs, with an undergrowth of western hemlock, in Willamette National Forest, Oregon. Below: A forest of mature pines, with a stand of young pines in the foreground, near Chapman, Ala



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Karl Weidmann — National Audubon Society

*Two types of forest.
Left: A tropical rain
forest in Venezuela.
Below: Typical coastal
rain forest of the Pa-
cific U.S.*

Washington State Dept. of Commerce



mental climate of the Northern Hemisphere and the oceanic climate of the Southern; see CLIMATE. (2) Deciduous monsoon forests, characteristic of Bengal and Burma (qq.v.). The climate is characterized by heavy daily rainfall, seasonally relieved by monsoons. (3) Tropical savanna forests found in regions such as the *campos* of Brazil where forest and grassland meet, composed of scattered trees on grassy ground, giving a parklike appearance. (4) Temperate coniferous forests, found in w. United States and typical of the colder parts of the temperate regions, dominated by pines and firs, scattering into gnarled scrub conifers at the tree line; see TUNDRA. (5) Tropical rain forests, characteristic of central Africa and the Amazon watershed. Plant growth is profuse and diverse and, since the fall and regrowth of leaves occur gradually throughout each year, the forest is always active. (6) Coastal rain forests, found along the Pacific coast of the U.S. and in other places as extensions of tropical rain forest into cooler regions due to the influence of warm ocean currents. (7) Winter rain forests of the temperate regions, with broad-leaved evergreen trees, common on Mediterranean coasts. (8) Tropical scrub forests, occurring in regions of slight rainfall, bordering wetter forests.

United States Forests. Three major forest areas exist in the U.S. The western forests of the Rocky Mts. and the Pacific coast produce primarily conifers, including Douglas fir, ponderosa pine, western white pine, Engelmann spruce, and white fir. More than half of the softwood lumber yield of the U.S. comes from the productive Douglas fir forests of the Pacific Northwest. Most other softwood production takes place in the South Atlantic and Gulf States, chiefly from longleaf, shortleaf, loblolly, and slash pines. Hardwoods, yielding about one fourth of the total production, are found in the eastern half of the U.S., with particularly dense stands occurring in the area surrounding the Mississippi and Ohio river valleys. Among the many hardwood species are several oaks, black walnut, yellow poplar, and sugar maple.

PUBLIC FORESTS. About 14 percent of the forest area of the U.S. is under the administration of the Forest Service (q.v.). Beginning with a single area in Wyoming, in 1891, the system of national forests had by 1974 expanded to more than 187,000,000 acres in forty-four States, Puerto Rico, and the Virgin Islands.

The earliest national forests, called forest reserves, were established through reservation of public lands. Present national forests, whose boundaries are established by Congress, cover

areas including about 20 percent private land, which the Federal government is acquiring gradually. Almost every State has a State forester, whose duties involve administration and protection of State forest lands. See FORESTS, NATIONAL AND STATE.

Canadian Forests. The forest lands of Canada stretch across the continent in a belt varying from 600 to 1300 mi. in width. Forests producing usable timber cover about 1,200,000 sq.mi. Coniferous trees make up four fifths of the total, deciduous trees the rest. The belt of conifers that extends from the Atlantic coast westward and northwest to Alaska includes spruce, balsam, fir, and pine, with poplar and white birch the principal deciduous species represented. South of this coniferous belt are the mixed forests of the Great Lakes, Saint Lawrence, and Acadian regions. Here the major conifers are eastern white and red pine, eastern hemlock, spruce, cedar, and fir. Also present are deciduous yellow birch, maple, oak, and basswood trees. On the western coast, in British Columbia, the large coniferous species provide more than one fourth of all wood cut in Canada annually. Most important are cedar, hemlock, spruce, fir, and Douglas fir.

About 90 percent of productive forest land is publicly owned. Its administration and protection is largely vested in the various provincial governments, which lease the forests to private industry. In the three Maritime Provinces, however, a sizable proportion of the forest land is privately owned. On the Federal level the Canadian Forestry Service of the Department of the Environment promotes improved management of forest resources and better products, in addition to providing advisory services to the provincial forestry administrations.

Disease and Pests. Insects and diseases are a continuing menace to forests. Various insects, such as the gypsy moth (q.v.), the tussock moth, and the spruce budworm, devastate extensive areas by defoliation. Other insects serve as carriers for the causative agents of diseases that destroy trees; see DUTCH ELM DISEASE. Parasitic tree diseases may be caused by bacteria, fungi, viruses, nematodes, or such parasitic plants as the mistletoe or dodder (qq.v.). Noninfectious diseases of trees include sunscald, drought injury, root drowning or suffocation, nutritional excesses or deficiencies, winter injury, and injury from smoke, gases, and fumes.

See articles on individual trees. See also CONSERVATION; DISEASES OF PLANTS; FORESTRY. **D.L.A. FORESTER, Cecil Scott** (1899-1966), British novelist, born in Cairo, Egypt (now Arab Repub-



Forest Service smoke jumpers parachute into an area where smoke columns indicate a fire. U.S. Forest Service

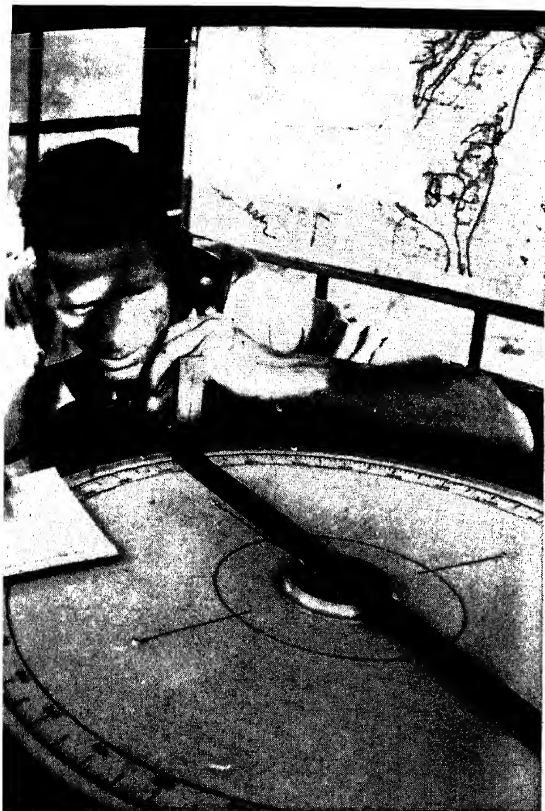
lic of Egypt), and educated at Dulwich College, London. His early works were a series of historical biographies. Forester subsequently wrote many novels, most of which were stories of sea adventures. Among these were *Captain Horatio Hornblower, R.N.* (1939), *The Captain from Connecticut* (1941), *Lord Hornblower* (1946), *Mr. Midshipman Hornblower* (1950), *Lieutenant Hornblower* (1952), *Hornblower in the West Indies* (1958), and *The Indomitable Hornblower* (1963). Historical works include *The Age of Fighting Sail* (1956), *The Naval War of 1812* (1957), and *Hunting the Bismarck* (1959). His autobiography, *Long Before Forty* (1968), was published posthumously.

FOREST FIRES. uncontrolled burning of forest vegetation ignited by accident (such as dropping a lighted cigarette), by destructive intent (such as arson), or by natural means (such as lightning). Foresters usually distinguish four types of forest fires: ground fires, which burn the humus layer of the forest floor but do not burn appreciably above the surface; surface fires, which burn forest undergrowth and surface litter; and crown fires, which advance through the tops of trees or shrubs. It is not uncommon for two or three types of fires to occur simultaneously. The excessive destruction of

United States forest by fire has necessitated an extensive program of fire control (see CONSERVATION: *Forest Conservation*). This control program has three major aspects: fire fighting, fire detection, and fire prevention.

Fire Fighting. Ground fires, once established, are difficult to extinguish. When the humus layer is not very deep, a ground fire may be extinguished with water or sand. Most ground fires, however, are controlled by digging trenches around the burning area and allowing the area to burn itself out. Surface fires are limited by clearing the surrounding area of low vegetation and litter, or digging emergency furrows to confine the area. Crown fires are difficult to extinguish. They may be allowed to burn themselves out, may be halted by streams or bodies of water artificially diverted into ravines or gullies, or they may be limited by backfired areas. Backfiring consists of carefully controlled burning of a strip of forest on the leeward side of the blaze, so that when the fire reaches the burned area it can go no farther.

Fire Detection. One of the most important aspects of forest-fire control is a system of locating fires before they are able to spread. Organized fire watching is carried on by patrols and look-outs in U.S. national forests, most State forests, and large private forests. Forest areas are carefully mapped. When a fire is observed by a lookout, who surveys an area from a high tower



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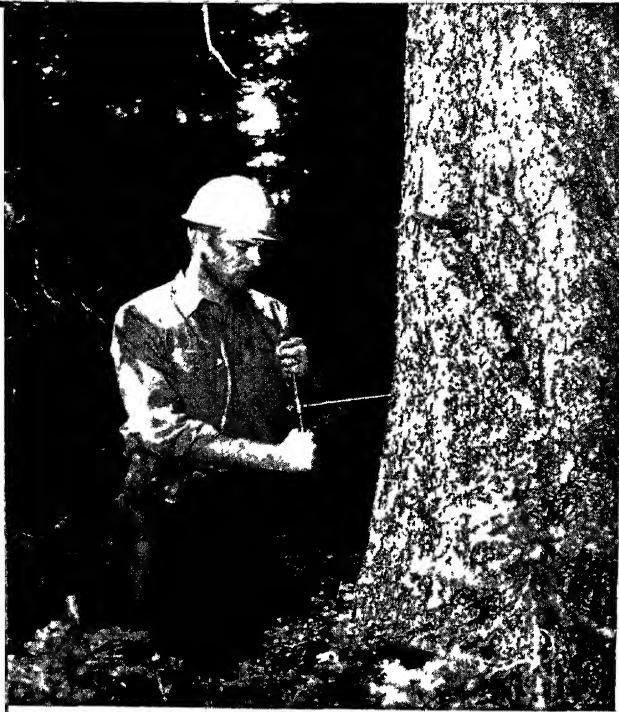


U.S. Forest Service

Developments in technology, chemistry, and many other fields are being steadily watched by foresters to improve fire-fighting methods. Above, left: A lookout, in a tower overlooking a forest, communicates with other lookouts and fire fighters in ground camps to plot the exact location of a blaze. Above, right: Where timber is light, air tankers can drop hundreds of gallons of chemical fire-fighting agents to douse the flames. Below: Strings of packhorses carry supplies into fire camps that are inaccessible by road.

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Above, left: A forester bores into the trunk of a tree to determine its age and growth rate. The information is useful in planning the long-term management of an entire timber district. Above, right: Twigs are shot off the tops of mature, healthy trees for grafting onto root stock in seedling orchards. The superior stands that result are less susceptible to disease and yield better timber. Below: A helicopter equipped with a hopper (at rear of cockpit) seeds a harvested timber region from the air. This technique is also used to replace timber stands destroyed by fire. Similarly equipped helicopters are used to scatter fertilizers.

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or an airplane, he determines the direction of the blaze and communicates with another lookout in the vicinity of the fire. The lines of direction from the observation points to the fire are then plotted on a map, the point of intersection of the lines indicating the location of the fire, and the nearest fire-fighting units are notified of the exact location.

Fire Prevention. The majority of forest fires are the result of human carelessness or deliberate arson. Fewer fires are started by lightning. Weather conditions influence the susceptibility of an area to fire. Such factors as temperature, humidity, and rainfall determine the rate and extent to which inflammable material dries, and therefore the combustibility of the forest. Wind movement tends to accelerate drying and to increase the severity of fires by speeding up combustion.

By correlating the various climatic elements with the inflammability of branch and leaf litter, the degree of fire hazard may be predicted for any particular day in any locality. Fire-danger meters, now a part of the field equipment of forest rangers, correlate relationships between weather and inflammability of forest materials for any given combination of conditions. Under conditions of extreme hazard, forests are frequently closed to the public.

Although organizations involved with fire control have traditionally attacked all wildfires, certain fires are a natural part of the ecosystem; see *ECOLOGY*. Complete fire exclusion may bring about changes in vegetational patterns and may also allow dangerous accumulations of fuel, with increased potential for feeding catastrophic fires. In some parks and wilderness areas, where the goal of management is to maintain completely natural conditions, lightning-caused fires may be allowed to burn under close surveillance.

See *FOREST*; *FORESTRY*. D.L.A.

FOREST PARK, city of Georgia, in Clayton Co., about 10 miles s. of Atlanta. Forest Park has varied manufacturing, including the production of sheet-metal goods. Corn, potatoes, and cotton are grown. The city was incorporated in 1908. Pop. (1960) 14,201; (1970) 19,994.

FOREST PARK, village of Illinois, in Cook Co., about 9 miles w. of central Chicago. Forest Park is a residential community and manufactures metal, paper, and wood products. It is the site of an Indian village and burial ground and a baseball museum. Founded in 1857, Forest Park was incorporated as the village of Harlem in 1884, receiving its present name in 1907. Pop. (1970) 15,472.

FORESTRY, management of forest lands for maximum sustained yield of forest resources and benefits; see *FOREST*. Although forestry originally dealt in the main with timber production, now it is also responsible for the management of grazing areas for domestic livestock, the preservation of wildlife habitats, watershed protection, and the development of recreational opportunities. Forestry therefore helps to ensure that wooded areas are used for maximum benefit according to their nature; see *CONSERVATION*; *ECOLOGY*.

History. Attempts at the regulation and management of forest lands occurred well before the 19th century in Rome, the Middle East, China, and western Europe. Wars and political instability invariably interfered with these efforts, so that destructive use of forests was common in the more densely populated countries. Early settlers in the United States, for example, regarded forests as impediments to cultivation and sought to remove them as quickly as possible. This attitude fostered a "cut and get out" philosophy among timber operators, and exploitative logging persisted well into the 20th century. Scientific forestry was initiated in the U.S. at the end of the 19th century largely through the influence of the Federal government, with measures including the establishment of the Division of Forestry in 1885, and authorization of forest reserves in 1897. The latter became known as the National Forests in 1905, when the jurisdiction of reserves was transferred from the Department of the Interior to the Department of Agriculture, and the Division of Forestry became the Forest Service (q.v.). Since that time marked progress has occurred in the management of forests on Federal, State, and private lands.

Education in technical forestry began in Western Europe about 1825 with private schools in France and Germany which were later replaced by state institutions. Until World War II Western Europe was the world leader in scientific forestry, establishing many famous schools and institutes. In the U.S. the first forestry curriculum was established in 1898. Forestry education has developed steadily and is now offered in many public and private universities throughout the country and in other parts of the world, especially in South America and Africa, where forest resources have been slightly developed to date.

Practice. Forestry comprises such specialties as dendrology, silviculture, forest protection, mensuration, engineering, utilization, and management. Dendrology is concerned with tree iden-

FORESTRY

tification, distribution, and species characteristics; see **TREE**. Silviculture studies the relationship of a forest to its environment and deals with the development, care, and reproduction of stands of timber. Forest protection examines sources of injury, including erosion (q.v.), fire, disease, insects, and animals. The science of measuring forest stands, including rate of growth and potential yield of standing timber, is called mensuration. Forest engineering deals with the mechanics of cutting and transportation involved in modern timber growing and harvest; see **LUMBER INDUSTRY**. Forest utilization considers the properties of wood (q.v.) and its conversion into lumber, plywood, paper, and other products. Forest management applies business methods and the principles of technical forestry to the overall operation of forest lands.

The practice of technical forestry includes many operations, from tree planting to harvest. Central to the operation is the cycle of cutting and replenishment. Four major methods have been developed for this purpose: clearcutting, selection, seed tree, and shelterwood. In clearcutting all trees in a given area are cut, and reproduction is obtained by artificial planting or by natural seeding from trees bordering the cleared areas. This method, adapted to light-demanding species, produces even-aged stands, allows control of stand composition, and is conducive to mechanized harvesting and disposal of slash, or logging debris. Selection cutting maintains a forest of mixed ages from which the largest and most mature trees are harvested periodically. Although this method is expensive and may cause injury to younger trees during logging, it provides continuous cover and an attractive forest. In the seed-tree method, about 10 percent of the trees in the cutting area are left in an evenly spaced pattern as a natural seed source. The shelterwood method involves the removal of the mature trees in a series of cuttings over a ten- to fifteen-year period. This method promotes natural reproduction and produces relatively even-aged stands.

Other practices contribute to the development of a sound forestry system. These include artificial planting by direct seeding or transplants, especially in conjunction with clearcutting; treatment with commercial fertilizers to increase production; the selection and breeding of commercial forest trees, producing strains that excel in growth, disease resistance, or other desirable characteristics; improved methods for controlling damage by insects; and better means

for limiting forest fires (q.v.). These measures fit into the pattern of an intensive forestry in which greater production will be obtained per acre and per man-hour through the application of technical knowledge, increased mechanization, and appropriate capital investment.

E.W.T.; D.L.A.

FOREST SERVICE, agency of the United States Department of Agriculture, established in 1905. The broad function of the service is the conservation and best use of the forest resources in the United States. The service manages the 155 national forests and 19 national grasslands in 41 States and Puerto Rico. Direct responsibility for the 187,000,000 acres in National Forest lands is divided among nine regional offices. The service conducts research in forestry, the use of forest products, and wildland management, through eight regional forest and range experiment stations, the Forest Products Laboratory at Madison, Wis., and the Institute of Tropical Forestry in Puerto Rico. It also provides technical and financial assistance to State agencies and private landowners to promote scientific forest-management practices. Forest rangers are encharged by the service with the management and protection of districts of national forests. See **AGRICULTURE**, **DEPARTMENT OF**.

FORESTS, NATIONAL AND STATE. About 754,000,000 acres, or roughly one third of the land area of the United States, are classified as forest lands. About one fourth of this forest land, or 187,000,000 acres, is within the National Forests, which are under the jurisdiction of the Forest Service (q.v.), an agency of the Department of Agriculture. These forests are administered through nine Forest Service Regions and the Institute of Tropical Forestry in Puerto Rico, within which are a total of 155 National Forests. The individual forests range in size from 10,778 acres in the Tuskegee National Forest in Alabama to the vast Tongass National Forest in Alaska, which covers more than 16,000,000 acres.

State-owned forests comprise approximately 18,000,000 acres, the bulk of which are in nine States: Alaska, 868,441 acres; Hawaii, 835,580; Idaho, 888,719; Michigan, 3,752,081; Minnesota, 2,984,500; New York, 677,575; Oregon, 786,707; Pennsylvania, 1,910,599; and Washington, 1,629,134. The remaining 3,700,000 acres are in thirty-six other States. D.L.A.

FORFARSHIRE. See **ANGUS**.

FORGERY, in criminal law, fraudulent making or altering of a writing or seal, to the prejudice of another man's right, or of a stamp to the prejudice of governmental revenue. In regard to

Forest Service Region	States Included ¹	Area of National Forest Lands (acres)	Number of National Forests	Location of Regional Office
1 Northern	Idaho, Montana, Washington, North Dakota, South Dakota	24,866,604	16	Missoula, Mont
2 Rocky Mountain	Colorado, Kansas, Nebraska, South Dakota, Wyoming	19,834,366	17	Denver, Colo
3 Southwestern	Arizona, New Mexico	20,470,555	12	Albuquerque, N Mex
4 Intermountain	Utah, Idaho, Wyoming, Nevada	31,041,496	18	Ogden, Utah
5 California	California, Hawaii	19,413,276	19	San Francisco, Calif
6 Pacific Northwest	Washington, Oregon	23,235,456	20	Portland, Oreg
8 ² Southern	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia	12,221,184	33	Atlanta, Ga
9 Eastern	Connecticut, Delaware, Illinois, Iowa, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin	11,186,123	17	Milwaukee, Wis
10 Alaska	Alaska	20,717,236	2	Juneau, Alaska
Institute of Tropical Forestry	Puerto Rico	27,998	1	Rio Piedras, Puerto Rico

¹Portions of some States are included in more than one National Forest Region

²Because of reorganization, there is no longer a Region 7.

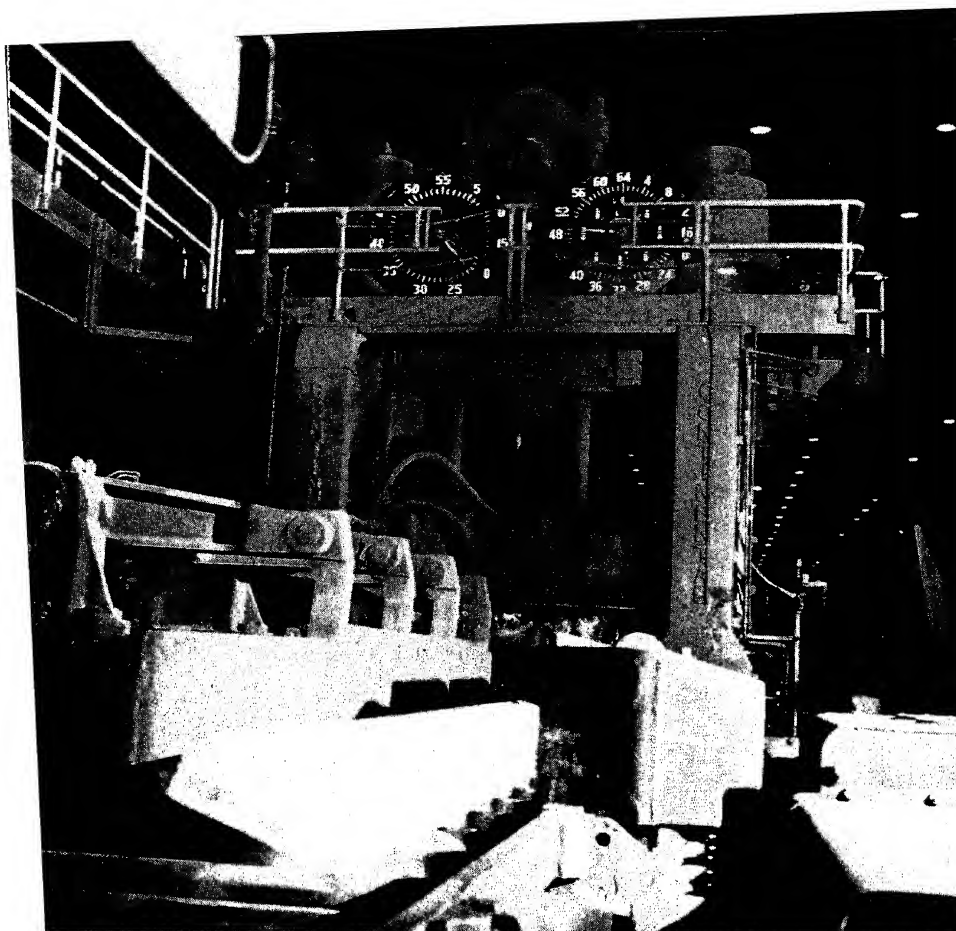
writings, the instrument forged must be executed with such skill or in such circumstances as to be capable of being mistaken for a genuine document by a person of ordinary intelligence and observation. It is not necessary that there should be an attempt at imitation of the handwriting of another or of the form of the simulated document. If there was intention to deceive, and the circumstances were such as to render deception possible, the crime has been committed, and consequently it is possible to forge the name of a person who cannot write. Any material alteration, however slight, such as the unauthorized appending of another's signature, is a forgery just as much as the transferring of a genuine signature to a document for which it was not intended, or the fabrication of an entire writing.

The offense is not limited to the fabrication of writing, but includes the fabrication of printed or engraved instruments, such as railroad and airplane tickets, corporation stock certificates, and bonds. Moreover the document fabricated

must have an apparent legal efficacy. A letter of introduction, although requesting a personal favor for the bearer from the one to whom it is addressed, is not a subject of criminal forgery; as such, a document does not purport to confer any legal right or to impose any legal duty.

To secure a conviction for forgery it is necessary to prove an intent to defraud, but it is not necessary that the purpose should have been actually effected; it is sufficient to show that the forgery would have proved injurious to another's interests. In the United States, Federal and State statutes define specific offenses as constituting the crime of forgery. See COUNTERFEITING, CRIME.

FORGET-ME-NOT, common name for plants of the genus *Myosotis*, belonging to the family Boraginaceae. They are found in temperate zones in all parts of the world. A number of species are common in ditches and damp meadows of the United States. The true forget-me-not, *M. scorpioides*, has creeping perennial roots with



In this intricate machinery, steel is forged into skelp and bloom shapes at a blooming mill. Skelps are used in the manufacture of pipe; blooms are processed further to produce small squares of steel called billets.

U.S. Steel Corp.

ascending stems bearing small sky-blue flowers. The most popular horticultural forget-me-nots are varieties of *M. sylvatica*, admired especially for their brilliant blue flowers. They are used extensively for ground cover in gardens and borders, and beside pools and streams. A dark blue species, the Azores forget-me-not, *M. azorica*, requires greenhouse cultivation in temperate regions.

FORGING, process of shaping iron and other malleable metals (q.v.) by hammering or pressing them after making them plastic by application of heat. The utility of forging techniques in the working of metal lies not only in the fact that the metal can be given the desired form, but also in that the process improves the structure of the metal, particularly the distribution of non-metallic phases. Forged metal is stronger and more ductile than cast metal, and exhibits greater resistance to fatigue (q.v.) and shock. Although forging is principally employed in the working of iron and steel, technological advances have made practical the forging of other metals, such as aluminum.

Hand Forging. Sometimes called smithing or blacksmithing, hand forging is the simplest form of forging and has been practiced throughout the course of history. The metal to be forged is

first heated to red heat in the fire of a forge, and then is beaten into shape on a metal anvil with sledges or hammers. The forge consists of an open hearth, made of some durable, refractory substance such as firebrick, which is provided with a number of air openings, or tuyeres, through which air is forced by a bellows or blower fan. Charcoal, coke, and coal are used as fuels in the forge. Hammers and other tools are employed by the blacksmith in the various forging operations.

In general there are six basic types of forging: upsetting, or decreasing the length and increasing the diameter of the metal; swaging, decreasing the diameter of the metal; bending; welding (q.v.), which is joining two pieces of metal together by semifusion; punching, the forming of small openings in the metal; and cutting out, the forming of large holes in the metal.

A piece of metal, called the work, is upset by striking it along the longest dimension, for example, the end of a rod or bar, at the same time shortening and thickening it. Swaging is accomplished by hammering the metal stock while it is held on the anvil within any one of various concave tools called swages. Bending is accomplished either by hammering the work around a form or by leverage against a sup-

porting fulcrum. In forge welding, a flux such as borax is first used to remove any oxides from the surfaces of the two pieces, and the pieces are then joined by hammering them together; a welded joint of this kind when properly made is entirely homogeneous and is as strong, that is, uniform as the parent metal. To punch small holes, the work is supported on a ring-shaped piece of metal atop the anvil, and a punch of the proper shape is driven through the work by hammer blows. Larger holes are cut out, and portions of the work are cut off with heavy, sharp chisels similar to cold chisels used to cut cold metal. By combining several of these operations, forgings of a wide variety of shapes can be produced.

Machine Forging. The chief difference between hand forging and machine forging is that in the latter technique various types of machine-powered hammers or presses are used instead of hand sledges. These machines enable the operator to strike heavy blows with great rapidity, and thus to produce forgings of large size and high quality as swiftly as required by modern production-line methods. Another advantage of machine forging is that the heavier the blows struck during forging, the greater the improvement in the quality of metallic structure. Fine-grain size in the forging, which is particularly desirable for maximum shock resistance, is obtained by working the entire piece until forging is complete. With large hand-forged metal, only the surface is worked, whereas the machine hammer or press will work the metal throughout the entire piece.

A special type of machine forging is drop forging, also called impact-die forging. Drop forging consists of forcing soft, hot metal into two shaping dies; see **DIE**. The upper one of these dies is hammered, or dropped, on the lower die, forcing the heated metal into the shaped die cavities, as in coin-making operations.

For reducing part of a piece of metal stock to a predetermined size, forging rolls are sometimes employed. These consist of a pair of grooved, cam-shaped rollers through which the metal is passed. The rollers touch each other and work on the metal during only part of each rotation, and therefore reduce only part of the stock that is fed to them.

Machine-forging operations are frequently accomplished by use of a series of dies mounted on the same press or hammer. The dies are arranged in sequence so as to form the finished forging in a series of steps. After the piece has been partially formed by one stroke, it

is moved to the next die for further shaping on the next stroke.

See **METALLURGY**; **METALWORK**.

C.F.F.

FORK, implement consisting of a handle or shaft and a shank terminating in two or more pointed and, usually, curved prongs, called tines. It is employed in such operations as piercing, holding, and manipulating an object. Of the many varieties of modern fork, the most common is the table fork, a utensil used to manipulate food. A service of table silver usually includes four types of fork: the large dinner fork with four tines; the entrée fork, similar to the dinner fork, but smaller; the short, broad salad fork with three or four tines, the extreme left tine being wider than the others and made with a cutting edge; and the small, narrow oyster fork, with three tines. Elaborate sets of silver may also include a fish fork and pastry fork similar to the salad fork, and an ice-cream fork, resembling a flattened spoon of which the bowl is divided into two broad tines, sometimes with one or more narrow tines between them.

The table fork, in various forms, is an ancient utensil, although it never became popular in the civilizations of antiquity. It was supposedly introduced into Venice in the 11th century by a Byzantine princess, although it did not become common, even among the aristocracy, until about four centuries later. The medieval fork was an article of great luxury, usually employed in eating fruits or sweetmeats. Owners of forks carried them on their persons together with the knives employed for cutting food. This custom persisted until about the 18th century. Early forks were made with a straight, shankless shaft, with a knob at one end and two straight tines at the other. Beginning with the late 17th century, the implement became heavier, a shaft was added to support the wider, tined end, and the number of tines was increased to three and, later, four. See **CUTLERY**.

FORLÌ (anc. *Forum Libii*), city of Italy, in Emilia-Romagna Region, and capital of Forlì Province, on the Montone R., about 40 miles S.E. of Bologna. Cereal grains and wine grapes are cultivated in the vicinity of the town, and extensive livestock is raised. The principal manufactures are machinery, furniture, textiles, and food products. Among the important buildings in the city are the 12th-century church of San Mercuriale, and the citadel, erected between 1360 and 1370, now used as a prison. Among the many treasures in the public art gallery is a fresco by the Umbrian painter Melozzo da Forlì (1438-94), pupil of the famous Italian master Piero della Francesca (q.v.). As *Forum Livii*, the town was an

FORM

ancient Roman trade center. It was an independent city from the 11th century A.D. until 1504, when it was made part of the Papal States (q.v.). Pop. (1971) 104,892.

FORM, term used in music to refer to the shape or structure of a composition. For a discussion of the methods by which a composer can achieve musical shape, see **MUSIC: Form**. For a discussion of the structural patterns and procedures that have been accepted by almost all composers during the course of the history of music, see **ARIA**; **CANTATA**; **CONCERTO**; **FUGUE**; **HYMN**; **MOTET**; **OPERA**; **ORATORIO**; **OVERTURE**; **RONDO**; **SONATA: The Sonata Form**; **SONG**; **SUITE**; **SYMPHONY**; **TOCCATA**.

FORMALDEHYDE, compound of carbon, hydrogen, and oxygen, with the formula HCHO or CH_2O , discovered in 1867 by the German chemist August Wilhelm von Hofmann (q.v.). It is the simplest of the aldehydes (q.v.). At ordinary temperature it is a gas with a very pungent odor. It can be compressed into a liquid that boils at -21°C . (-5.8°F). Formaldehyde is prepared industrially by heating dry air and methyl alcohol vapor in the presence of a catalyst, such as copper, platinum, or vanadium pentoxide. More direct processes, whereby formaldehyde is synthesized from carbon monoxide and hydrogen, have been developed. In one process, water gas is passed over a catalyst at a temperature between 200°C . and 300°C . (392°F . and 572°F .) under a pressure of 150 lb. per square inch.

Formalin is a trade name for a solution containing 40 percent formaldehyde and 60 percent water or water and methyl alcohol; it is employed as a disinfectant, insecticide, fungicide, and deodorant. Formaldehyde is used extensively in the chemical industry in the synthesis of organic compounds. The most important use of formaldehyde is in the manufacture of synthetic resins; see **PLASTICS**; **POLYMER**.

FORMICA, trademark for various laminated thermoplastics, used commonly as surface finishes of furniture and counter tops. See **PLASTICS**.

FORMIC ACID, HCOOH or H_2CO_2 , the simplest of the fatty acids (q.v.) and the simplest of all organic acids. It was first obtained in 1670 by the distillation of red ants (Lat. *formica*, "ant"). A reducing agent (one which reduces the amount of oxygen in a compound), formic acid is sufficiently powerful to form the less active metals, gold, platinum, mercury, and silver, from neutral or slightly acidic solutions of salts of these metals. Formic acid is also used to precipitate solid rubber from liquid latex. In the tanning and textile industries, it is useful because

of its acidic, disinfectant, and preservative qualities.

FORMOSA, island of Asia, in the Pacific Ocean, since 1949 the seat of the government of the Republic of China. See **TAIWAN**.

FORMOSUS (816?–96), pope from 891 to 896, born probably in Rome. During the struggle for the crown of the Holy Roman Empire (q.v.), he sided with the German faction against Pope John VIII (see under **JOHN**) and was excommunicated in 872. Formosus was restored to his bishopric in 883 and was elected pope on the death of Stephen V (see under **STEPHEN**) in 891. After Arnulf (q.v.), King of Germany, captured Rome in 895, Formosus crowned him Holy Roman emperor.

FORMS OF ADDRESS, conventional means of addressing persons of distinction. In some foreign countries the forms of address are elaborate. In the United States they are relatively few and simple and, as sanctioned by usage, include the following.

In direct speech the President is addressed as *Mr. President*; in written communications he is addressed as *Dear Mr. President*. In diplomatic communications from other governments the President is styled *Excellency*. Similar forms are used for the Vice-President. Members of the Cabinet are addressed as *Dear Mr. Secretary* and are referred to as *The Honorable John Doe*. The governors of the States are addressed as *The Honorable John Doe*, *Governor of Delaware*. The mayors of cities are also called *The Honorable*.

The Chief Justice of the United States is addressed as *Dear Mr. Chief Justice*, the other Supreme Court justices as *Dear Mr. Justice*. All justices in the U.S., Federal, State, and local, are addressed as *The Honorable Mr. Justice Doe*.

Members of the upper house of Congress are styled *The Honorable John Doe* and addressed to United States Senate when at their Washington offices; when away from Washington their local address is used. All Congressmen and the members of the State legislatures are referred to as *The Honorable John Doe*.

Such professional titles as *doctor* sometimes precede the name of a physician or a professor, but more usually follow it in the form of the appropriate initials, as in the case of "John Jones, M.D."

Clergymen are addressed as *The Reverend John Doe*; never as *Reverend Doe*. Protestant Episcopal bishops are addressed as *The Right Reverend*, with the formal salutation of *Right Reverend Sir*, and, informally, *Dear Bishop*. Methodist Episcopal bishops are addressed as

The Reverend, with the formal salutation of *Reverend Sir*, and the informal one of *Dear Bishop*.

The form of address for Roman Catholic priests is *The Reverend* and *Dear Father*; for bishops and archbishops, *The Most Reverend* John Doe and *Your Excellency*; for cardinals, *His Eminence*, John Cardinal Doe and *Your Eminence*; and for the pope, *His Holiness*, Pope Paul VI and *Your Holiness*.

FORREST, Edwin (1806–72), American actor, born in Philadelphia, Pa. He made his first appearance on the stage in 1820 in Philadelphia, Pa., in the controversial tragedy *Douglas*, by the Scottish playwright and minister John Home (1722–1808), and made his New York debut in 1826 in Shakespeare's *Othello*. He played throughout the United States, and first appeared in London, England, in 1836 as Spartacus in *The Gladiator* by the American playwright and novelist Robert Montgomery Bird (q.v.). During a second trip to London in 1845, Forrest was hostilely received, which he attributed to the influence of the British actor William Charles Macready (q.v.), Forrest's long-standing rival. The feud between the two actors, which began as a conflict over acting styles and divided audiences into pro-British and pro-American factions, led to a mob attack on the Astor Place Theatre in New York City on May 10, 1849. During the riot twenty-two people were killed and thirty-six wounded. This tragedy and a sensational divorce suit brought by his wife Catherine Norton Sinclair (1817–91) in 1850 did not diminish Forrest's reputation as an actor, and he continued to command large audiences in the U.S. until his retirement from the theater in 1871. Forrest encouraged native American drama by offering large money prizes for plays by American authors and producing those selected. He left a large part of his fortune to found the Edwin Forrest Home for aged actors in Philadelphia.

FORREST, John, 1st Baron Forrest (1847–1918), Australian explorer and statesman, born in Bunbury, Western Australia. He entered the government survey department in 1865, and in 1870 he headed an exploring party that traced the shore line of Australia from Perth to Adelaide. In 1874 he headed another expedition from Geelvink Channel on the west coast to the overland telegraph line between Port Darwin and Adelaide, a distance of about 2000 mi. He was knighted in 1891. From 1890 to 1901 he served as first premier of the newly organized government of the State of Western Australia. Between 1901 and 1907 Forrest was a member of

the first national cabinet of Australia and served in various posts in subsequent administrations. In 1918 he was elevated to the peerage, the first statesman of Australia to be so honored.

FORREST, Nathan Bedford (1821–77), American Confederate cavalry general, born near Chapel Hill, Bedford Co., Tenn. After dealing in horses and cattle in Mississippi, he became a slave trader in Memphis, Tenn. At the start of the Civil War (see CIVIL WAR, THE AMERICAN) he enlisted as a private in the Confederate Army, and subsequently raised a battalion of cavalry, of which he was made lieutenant colonel. In 1862 he led his forces in the defense of Fort Donelson and later participated in the Battle of Shiloh; see SHILOH, BATTLE OF. Following a series of successful raids throughout Tennessee, Alabama, and Mississippi in November, 1864, he was given command of all the cavalry with the Army of Tennessee. Among his victories in 1864 was the capture of Fort Pillow (q.v.). At the beginning of 1865 he was placed in charge of the cavalry in Alabama, Mississippi, and east Louisiana, and was made a lieutenant general. In March he was defeated at Selma, Ala., by the Union general James Harrison Wilson (1837–1925), and he and his forces surrendered in May. Forrest was one of the most effective Confederate generals. Following the war he settled in Memphis, where he owned two large plantations. He is believed to have been the first head of the original Ku Klux Klan during the period of Reconstruction (qq.v.).

FORRESTAL, James Vincent (1892–1949), American banker and government official, born in Beacon, N.Y., and educated at Dartmouth College and Princeton University. In 1916, he joined the New York City investment banking firm of Dillon, Reed and Company. He became president of the firm in 1938. Two years later Forrestal was appointed undersecretary of the navy and served in that post until 1944, when he was elevated to the secretaryship of the navy. He was one of the chief planners of the unification of the three armed services under a single executive department of the Federal government; see DEFENSE, DEPARTMENT OF. In 1947, when unification was effected by congressional enactment, Forrestal became the first secretary of defense of the United States. He resigned the post because of ill health early in 1949.

FORREST CITY, city in Arkansas, and county seat of Saint Francis Co., about 90 miles N.E. of Little Rock. The city is a marketing center in an agricultural region. Manufactures include electrical equipment, clothing, and metal products. Cotton, corn, strawberries, and peaches are

grown. Settled in 1867 the city was incorporated in the early 1870's. Pop. (1960) 10,544; (1970) 12,521.

FORSSMANN, Werner (1904–), German surgeon, born in Berlin, and educated at the University of Berlin. In 1957, as chief doctor at the surgical clinic of Düsseldorf Evangelical Hospital, he originated an important cardiologic technique, called catheterization, that is used in the diagnosis of heart disease. He first demonstrated the technique in 1929, while at the Eberswalde clinic, by experimenting upon himself. He made an incision in a vein in his right arm and maneuvered a catheter up the vessel and into the right auricle of his heart by observing via a mirror the fluoroscoped image of the instrument as it traveled through his body. In a scientific paper, Forssmann showed the practicability of the cardiac-catheterization method in studying heart physiology. For this experiment he shared the 1956 Nobel Prize in medicine and physiology with the French-born American cardiologist André Frédéric Cournand and the American cardiologist Dickinson Woodruff Richards (qq.v.).

FORSTER, Edward Morgan (1879–1970), British novelist, born in London, England, and educated at King's College, University of Cambridge. His first novel, *Where Angels Fear to Tread* (1905), appeared when he was twenty-six years of age and displayed an unusual maturity of style. During World War I Forster lived in Alexandria, Egypt, where he was a civilian per-

forming wartime duties. After the war he served briefly as literary editor of the *Daily Herald*, a Labour Party newspaper. In 1921 he made a trip to India. His most popular novel, *A Passage to India*, appeared three years later. In this work, by delicately studying the personal relationship between a Britisher and an Indian, Forster uncovers the basic tensions existing between the two civilizations. Among his other works are the novels *The Longest Journey* (1907), *A Room with a View* (1908), and *Howards End* (1910). Two books written by Forster on primarily homosexual themes were not published until after his death. They are *Maurice* (1971), a novel, and *The Life to Come* (1972), a collection of short stories.

Forster's reputation as one of the most important modern British novelists is based on a relatively small number of works, including six novels, three volumes of short stories, and a few critical and miscellaneous works. The primary theme in his writings is that a blind acceptance of the values and conventions of the British middle class of his time tended to foster narrow and uncompromising attitudes that could raise dangerous artificial barriers between people, at the expense of spontaneous human passion.

FORSYTHIA, small genus of yellow-flowered ornamental shrubs, native to Asia and s.e. Europe, belonging to the family Oleaceae or olive (q.v.). The genus, comprised of about eight species and several hybrid varieties, is named for the British royal gardener William Forsyth (1737–1804). The plants vary in height from 5 ft. to 10 ft. The bell-shaped flowers, ½ to 1 in. long, are closely set on graceful, drooping branches and blossom in the early spring before the leaves appear. The slender green leaves, between 2 and 6 in. long, sometimes turn dark green, olive, or purple in autumn. The plants are hardy, growing well in a variety of soils, and are used frequently in hedges or borders. The most popular species are *F. suspensa* and *F. viridissima*.

FORT, Paul (1872–1960), French poet, born in Reims. In 1890 his one-act prose comedy *La Petite Bête* (Eng. trans., "The Little Beast") was published, and in the same year he founded the Théâtre d'Art (later the Théâtre de l'Oeuvre) to provide a stage for the dramas of the French school of Symbolists (q.v.). The magazine *Vers et Prose* ("Poetry and Prose"), which he founded in 1905 and edited until 1914, played an important part in the history of French symbolism. Fort is particularly noted for his ballads, in which he used traditional themes of popular poetry. Most of his work is included in the

Edward Morgan Forster

Harcourt, Brace and World, Inc.





Forsythia is sometimes called golden bells because of the shape and color of the blossoms. Hugh Spencer—
National Audubon Society

thirty-eight volumes of *Ballades Françaises et Chroniques de France* ("French Ballads and French Chronicles") that he published between 1897 and 1937.

FORTALEZA or CEARÁ, city and seaport in Brazil, and capital of Ceará State, on the Atlantic Ocean, about 7 mi. from the mouth of the Ceará R., and about 275 miles N.W. of Natal. The Pajeú, a branch of the Ceará, runs through the city, dividing it into two sections. Fortaleza is one of the chief seaports of Brazil and has additional harbor facilities at Mucuripe Point, 5 mi. to the E. The chief commodities exported from Fortaleza are coffee, cotton, carnauba wax, beans, rice, sugar, fruits, rubber, hides, skins, and rum. Fortaleza was founded in 1611. It became the capital of Ceará State in 1810 and was incorporated as a city in 1823. Pop. (1970 prelim.) 520,175.

FORTAS, Abe (1910–), American lawyer and jurist, born in Memphis, Tenn. He received a B.A. degree from Southwestern College in Memphis in 1930 and a law degree from Yale University in 1933. At Yale he served as editor in chief of *The Yale Law Journal*. Graduating first in his class, he was immediately appointed to the faculty of the law school. From 1937 to 1946, Fortas held a variety of positions in the Federal government, among which was an undersecretaryship in the Department of the Interior from 1942 to 1946. In 1946 he left government service to practice law, but his advice on legal and po-

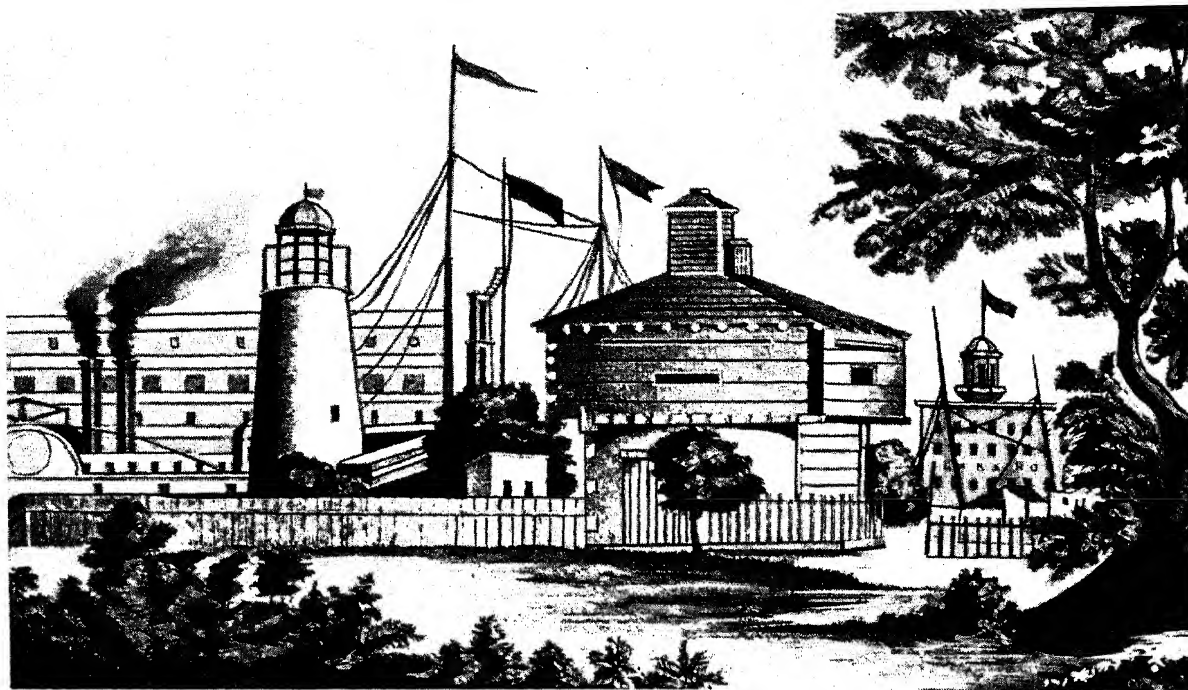
litical matters was continuously sought by the government. He was appointed to the Supreme Court of the United States by President Lyndon B. Johnson (q.v.) in 1965, taking the seat of Associate Justice Arthur J. Goldberg (q.v.). In 1968 Fortas was nominated by President Johnson to replace Chief Justice Earl Warren (q.v.). Confirmation by the U.S. Senate was blocked by a filibuster, and after a motion to end the filibuster failed, the nomination was withdrawn at the request of Fortas. In May, 1969, Fortas resigned from the Court. He was the first member of the Supreme Court to resign under pressure of public criticism, his outside financial interests having been widely held to be inconsistent with the conduct traditionally expected of a member of the court. After leaving the Court he resumed his private law practice.

FORT BOWIE NATIONAL HISTORIC SITE, ruins of a fort in S.E. Arizona. The original fort was built in 1862 to secure the vital Apache Pass and assure access for American troops to the water of Apache Springs. It was rebuilt in 1868 at a nearby location with enlarged and improved facilities. After Geronimo's surrender in 1886 military activities were curtailed, and the fort was finally deactivated in 1894. It is administered by the National Park Service (q.v.).

FORT CAROLINE NATIONAL MEMORIAL, historic area in Florida, 10 miles E. of Jacksonville, site of a French colony, one of the first European settlements in North America. The fort was built in 1564 with the help of friendly Indians and named in honor of Charles IX (q.v.), King of France. Although France hoped for a share in the New World claimed by Spain, Fort Caroline was captured by a Spanish force in 1565. The fort has been completely reconstructed. It is administered by the National Park Service (q.v.).

FORT CLATSOP NATIONAL MEMORIAL, area of historic interest in Oregon, about 4 miles S.W. of Astoria, site of the 1805–06 winter headquarters of the Lewis and Clark expedition (q.v.). In 1805, after reaching the Columbia R. estuary, the party built an encampment which they named Fort Clatsop for the neighboring Clatsop Indians. When the expedition departed in 1806 for the journey home the fort was presented to the Clatsop chief in appreciation of his friendship. A replica of the original settlement was built in 1955. It is administered by the National Park Service (q.v.).

FORT COLLINS, city in Colorado, and county seat of Larimer Co., on the Cache la Poudre R., 55 miles N. of Denver. It is a trade center for the area, which raises livestock and grows sugar



Fort Dearborn in 1856.

beets, grain, vegetables, and fruit. Industries include grain and flour milling, meat and dairy processing, and the manufacture of machinery, woolens, and brick. Fort Collins is the site of Colorado State University (1879). Nearby are the Lindenmeier archeological site and Fort Collins Mountain Park, a nature reserve. The city developed around Camp Collins, a military post from 1864 to 1871. Pop. (1960) 25,027; (1970) 43,337.

FORT DAVIS NATIONAL HISTORIC SITE, former military post in Texas, N. of the town of Fort Davis, built in 1854 to station army garrisons assigned to protect travelers from attacks by Comanche and Apache Indians on the Overland Trail. For eighteen years soldiers of the Negro 9th U.S. Cavalry under white officers were garrisoned there. In a final encounter in 1880 between the Apache and U.S. troops, including units from Fort Davis, the Indians were driven back to Mexico. With more than fifty adobe and stone structures, Fort Davis was a major frontier installation. It is administered by the National Park Service (q.v.).

FORT DEARBORN, historic United States Army post, consisting of a stockade and two blockhouses built in 1803 on the site of the present city of Chicago (q.v.). It was named in honor of the American politician and general Henry Dearborn (1751–1829), United States secretary of war at that time. The fort stood at the mouth of the Chicago R., on a small tract of land that had been ceded to the U.S. by the Indians in 1795. In the early part of the War of 1812 (q.v.), the garrison of sixty-seven men evacuated the fort in accordance with an order from Gen-

eral William Hull (1735–1825), at Detroit, as the British and their Indian allies were gaining control of the surrounding area. Accompanied by the resident settlers, the garrison started for Detroit with a body of supposedly friendly Indians. On the way, the Indian escort party joined with another large force of Indians and attacked the group. Two thirds of the Americans were killed and the rest were captured; several of those taken captive were subsequently ransomed at Detroit. The fort was destroyed on the following day by the Indians. It was rebuilt in 1816 on a larger scale and was strongly garrisoned. The city of Chicago grew up around the fort.

FORT-DE-FRANCE, capital, seaport, and commercial center of the island of Martinique, an overseas Department of France in the French West Indies. The city is situated on the Bay of Fort-de-France, on the w. coast of the island, and has a fine, landlocked harbor defended by three forts. Once called Fort-Royal, its trade became important after the destruction (1902) of the town of Saint-Pierre by Mont Pelée (qq.v.). Sugar, rum, and canned fruits are the chief exports. A statue of Joséphine de Beauharnais, Empress of France (see under **BEAUHARNAIS**), who was born in Martinique, is in a public garden in the city. Pop. (1967) 96,943.

FORT DODGE, city in Iowa, and county seat of Webster Co., on the Des Moines R., 85 miles N.W. of Des Moines. It is noted for the manufacture of many varieties of gypsum and clay products, and is an important grain market. Other industries in the city are meat packing, the processing of soybeans, and the manufacture of agricultural machinery. Gypsum from Fort Dodge was used in the famous "Cardiff giant"

hoax in 1868, when a statue carved from the material was buried near Cardiff, N.Y. The statue was discovered a year later by some well diggers, causing great excitement, but the deception was soon discovered.

In the vicinity of the city is Woodman Hollow State Monument, a wildlife preserve. The city grew up around Fort Clarke, established there in 1850 and renamed Fort Dodge in 1851 in honor of Henry Dodge (1782–1867), Governor of the Territory of Wisconsin (1836–41) and United States Senator from Wisconsin (1848–57). It became a city in 1869. Pop. (1970) 31,263.

FORT DONELSON NATIONAL MILITARY PARK, battle site in Tennessee, on the left bank of the Cumberland R. It contains an old Confederate fort of the same name, built early in the American Civil War, a monument to Confederate soldiers, and Fort Donelson National Cemetery. The fort is well preserved and the earthworks, rifle pits, and other fortifications of the period are intact.

Fort Donelson was the site of a decisive battle of the Civil War; see CIVIL WAR, THE AMERICAN. After Fort Henry (q.v.) had fallen to a Union flotilla commanded by Commodore Andrew Hull Foote (q.v.) on Feb. 6, 1862, General Ulysses Simpson Grant (q.v.) marched overland to lay siege to Fort Donelson, while the gunboat flotilla under Commodore Foote ascended the Cumberland R. to meet him. About 3000 Confederate troops had escaped from Fort Henry to Donelson, bringing the total Confederate strength to about 21,000 men, under the command of General John Buchanan Floyd (q.v.), assisted by General Gideon Johnson Pillow (1806–78) and General Simon Bolivar Buckner (q.v.). Grant attacked the fort unsuccessfully with about 16,000 men on February 13 and again on February 14, also without success and with heavy Union losses. The Confederates, hoping to break through the Union lines and escape to Nashville, attempted a surprise attack on February 15. They succeeded in opening the road to Nashville but failed to take advantage of it, and Grant ordered a general advance which succeeded in driving the Confederates back within their own lines. During the night Floyd and Pillow escaped from the fort by steamer, leaving Buckner in command. On the morning of February 16, Buckner sent a message to Grant, asking to settle terms of surrender. Grant returned the now-famous reply: "No terms except unconditional and immediate surrender can be accepted". Buckner surrendered the fort and between 12,000 and 15,000 men as prisoners of war. During the battle about 2000 men on each

side had been killed or wounded. The fall of Fort Donelson broke the Confederate first line of defense for the Mississippi Valley, splitting the Confederate States and forcing the evacuation of Columbus and Bowling Green, Ky., and Nashville, Tenn.

The park, covering 600 acres, was established in 1928. It is administered by the National Park Service (q.v.).

FORT DUQUESNE. See PITTSBURGH: *History*.

FORT ERIE, town and port of entry of Canada, in Welland Co., Ontario Province, on Lake Erie, at the head of the Niagara R., about 60 miles s.e. of Toronto, opposite Buffalo, N.Y. It is connected with Buffalo by a railroad bridge and by the Peace Bridge. A boulevard along the river offers a scenic drive to Niagara Falls. Industrial establishments in the town include chemical plants, and factories manufacturing steel, airplanes, paints, and varnishes. Fort Erie, around which the town arose, is in Government Park. It was restored in 1939 and contains many relics of the War of 1812 (q.v.), during which the fort was the site of several battles. The original fort was built in 1764. The town of Fort Erie was formed in 1931 by joining the village of Fort Erie and the town of Bridgeburg. Pop. (1976) 24,031.

FORT FREDERICA NATIONAL MONUMENT, area of historic interest in Georgia, on the w. shore of Saint Simons Island, near Brunswick. The area contains the ruins of Fort Frederica, an earthwork fortification constructed in 1736 by General James Edward Oglethorpe (q.v.), founder of the colony of Georgia (q.v.), and named in honor of Frederick Louis (1707–51), the eldest son of George II (q.v.), King of Great Britain. The fort, which commanded the channel between the island and the mainland, was erected as a defense for the British colonists in Georgia against the Spanish in Florida (q.v.). In 1742 a Spanish force dispatched from Cuba threatened the settlers, but the expedition was turned back a few miles s. of the fort by Oglethorpe in the Battle of Bloody Marsh. Among the ruins of Fort Frederica are an encircling moat and several buildings constructed of tabby, a mixture of lime, sand, and oyster shells. The monument, covering 250 acres, was established in 1945. It is administered by the National Park Service (q.v.).

FORT GARRY. See WINNIPEG: *History*.

FORTH, Great Britain, river and firth of Scotland. The Forth rises near Aberfoyle, Perth County, by the juncture of the two headstreams, the Avondu R. and Duchray Water. It drains an area of 645 sq.mi., and forms the boundary between Perth and Stirling counties up to a short

FORTH BRIDGE, THE

distance N. of the city of Stirling, the county seat, where it is joined by the Teith R. The Forth R. then crosses N.E. Stirling County and widens into the Firth of Forth. The total length of the river is 66 mi. The firth extends 48 mi. to the North Sea, and is 17½ mi. wide at its mouth. Clackmannan and Fife counties border the firth on the N. and the counties of Stirling, West Lothian, Midlothian, and East Lothian border it on the S. At Queensferry, West Lothian, the river is spanned by the Forth Bridge, a cantilever railway bridge 5330 ft. long, with two main spans of 1710 ft. each, built in 1890. Nearby is the Forth Road Bridge, a suspension bridge, 3300 ft. long, built in 1964. The Forth is navigable to Alloa, Clackmannan, by vessels up to 300 tons, and as far inland as Stirling by vessels up to 100 tons. The firth is connected to the Firth of Clyde (see CLYDE) by the 38-mi.-long Forth and Clyde Canal. Bo'ness, Burntisland, Grangemouth, Kirkcaldy, and Leith are the principal ports on the Firth of Forth. The modern naval base of Rosyth is situated a short distance W. of Forth Bridge. Important salmon and herring fisheries and resorts are located along the lower course of the Forth R.

FORTH BRIDGE, THE. See *BRIDGE: Modern Bridges: Cantilever Bridges.*

FORT HENRY, Confederate fort built early in the American Civil War (see CIVIL WAR, THE AMERICAN) on the right bank of the Tennessee R., near the boundary with the State of Kentucky. Together with Fort Donelson (see FORT DONELSON NATIONAL MILITARY PARK) it constituted the most important link in the first line of Confederate defense in the Mississippi Valley. Early in 1862, to gain control of the Mississippi Valley and split the Confederate States in two, the North planned the capture of the forts. General Ulysses Simpson Grant (q.v.), in command of about 17,000 men on transports, and Commodore Andrew Hull Foote (q.v.), commanding a flotilla of gunboats, moved up the river to Fort Henry, which was defended by about 3000 men under General Lloyd Tilghman (1816–63). On the morning of February 6, Commodore Foote attacked the fort alone, because the transports bearing General Grant and his men were delayed. The garrison of the fort was enabled by the delay to withdraw by land to Fort Donelson, 12 mi. distant on the Cumberland R., leaving a small artillery detachment which returned the fire of the Union gunboats for over an hour until forced to surrender.

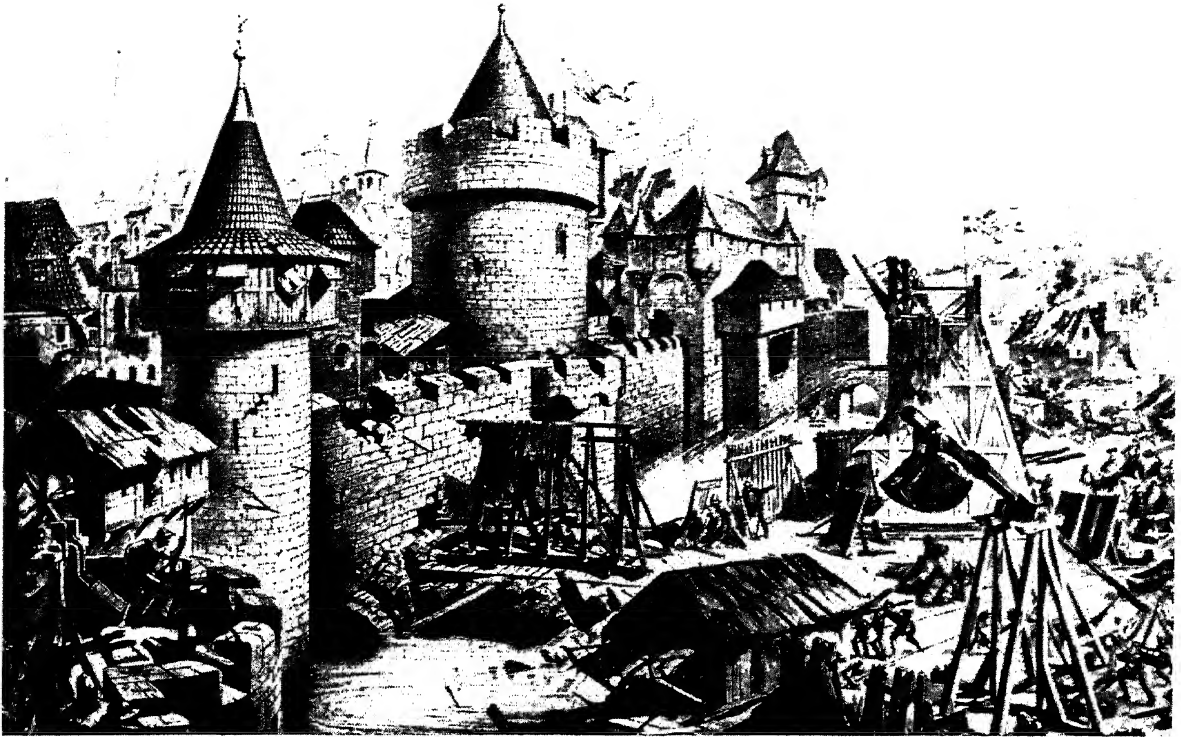
FORTIFICATION AND SIEGECRAFT, related branches of the art of military engineering (q.v.). Fortification deals with the design and

construction of defensive structures; siegecraft is concerned with systematic methods and means for the attack on and capture of such works. Defensive structures may be permanent or temporary. Examples of permanent defensive works are city walls, the castles of the Middle Ages, and the frontier fortresses and harbor defenses of relatively modern times. The construction of permanent defensive works implies a continuing requirement for the protection of political, economic, or military interests associated with a particular locality, and also the existence of a continuing threat to those interests. See WARFARE.

Temporary and Fixed Positions. The development of temporary or field fortification is associated with the tactical requirements in the field. Examples include the palisaded camps built by the Roman legions for overnight halts, the pointed wooden stakes used by English foot soldiers to throw enemy cavalry into confusion under arrow fire, or the various applications of trench-digging and sandbagging to the tactical conditions of the age of gunpowder. When a moving situation becomes stabilized, a hastily occupied defensive position may have to be developed into a more strongly fortified position; the classic example of such a development is the stabilization of the western front in Europe during World War I (q.v.), when trenches and other temporary works became permanent fortifications.

The primary aim in fortifying a fixed position has been to erect a physical barrier that cannot be suddenly overrun and that is strong enough to enable the defending force to hold it for a period of time. In African village warfare, a thick thorn hedge might serve this purpose, especially if it were green enough not to catch fire. On the American frontier, a stockade of logs firmly set in the earth and loopholed for musketry proved a most useful type of fortification. Over the ages the classic defensive barrier has been a masonry wall surrounding the area to be defended, and usually itself surrounded by a deep ditch.

The attack on and defense of masonry structures, whether city walls, isolated forts and castles, or extensive barriers such as the Median Wall between the Tigris and Euphrates rivers in Mesopotamia (q.v.), the Great Wall of China (see GREAT WALL), or the variety of frontier walls built by the Romans against barbarian attack, involved three basic concepts which remained unaltered until the age of gunpowder. In order to get at the defenders, the attackers had to get over the top of the wall, break a passage through it, or burrow underneath it. The tech-



A medieval fortress under siege.

Bettmann Archive

niques of siegecraft were directed toward the accomplishment of these aims, singly or simultaneously, and the techniques of fortification toward preventing such accomplishment. As long as human muscles remained the principal source of energy by which these techniques could be applied, it is not surprising that comparatively little novelty of method is apparent between the siege tactics of the Assyrians in the 3rd millennium B.C. and the attack and defense of medieval castles in Europe in the 13th and 14th centuries.

The techniques of fortification and siegecraft interacted on each other, with fortifiers seeking the ideal of the impregnable fortress while besiegers strove to develop the irresistible siege; the effectiveness with which these aims were pursued varied widely through history. Natural defensive strength was sought in the selection of city sites. In Greece, for example, the huge rock of the Acropolis (q.v.) was the location of the earliest Athenian settlers; the seven hills of Rome amid the marshes of the Tiber R. provided a strong defensive situation for that city, the earliest nucleus of which was on the Palatine hill; the Phoenicians of the ancient city of Tyre, finding their coastal position too exposed to marauders, moved to an offshore island and added a water barrier to their defenses. The art of fortification developed through local necessities, and as the wealth of the cities grew, often

became undermined by complacency. The art of siegecraft, on the other hand, was stimulated by the efforts of would-be conquerors.

Siegecraft Techniques. The techniques of siegecraft demanded enormous labor. Movable wooden towers, or *belfroi*, were built, from which weapons, bows, and slings could be used against the garrison, and from which the top of the wall could be attacked across wooden bridges if the tower could be brought close enough. Such towers were of enormous weight; one used at the siege of Rhodes by Demetrius I, King of Macedonia (see *under* DEMETRIUS) in 305 B.C. required 3400 men to move it. The ground always had to be made perfectly level, and the ditch filled in. Men in the lower stories of the tower attacked the wall with battering rams, consisting of tree trunks swung by ropes from overhead beams, with rounded metal heads to crumble the masonry, or by borers, which were similar devices with ax-shaped heads to attack crevices, and to wrench stones out of the face of the wall. The defenders, in turn, would normally attack the wooden tower with fire, against which raw hides were the usual method of protection.

Missile-throwing engines included the catapult, which, in principle, was a giant spear-throwing crossbow attached to a timber stand,

FORTIFICATION AND SIEGECRAFT

and the ballista, which used the torsion of heavy cords twisted between two uprights to throw stones weighing up to 100 lb. each, though with little accuracy. Only in the 13th century A.D. was a reasonably accurate stone-throwing engine, the *trebuchet*, produced; in this, a heavy weight attached to the short end of a pivoted length of timber was released by a trigger, the projectile being thrown from the long end of the timber.

Advent of Artillery. The development of artillery (q.v.) revolutionized fortification and siegecraft. In 1453, the enormous walls of Constantinople (now Istanbul, Turkey), the last seat of imperial Roman power, were breached by the guns of the Turkish sultan Mohammed II (1430–81). In the same year, French artillery defeated the last English army remaining on French soil and brought the Hundred Years' War (q.v.) to an end. After 1453, fortifiers found that earthwork proved a far more reliable protection than masonry against cannonballs as the defense began to depend more and more on providing clear fields of fire for the musketry and artillery of the defenders. The ditch became a basic feature in fortification, and siege artillery became the principal means of attack. The ditch usually had a gently sloping approach, called the *glacis*,

swept by the fire of the defenders from a rampart behind the ditch, the ramparts being just high enough to command the glacis. The trace, or general ground plan of a fortified position, grew more elaborate as fortifiers sought to combine protection with effective fire. The bastioned trace became a governing principle of fortification, the guns on the faces of the bastion, which was an outward-pointing triangle, covering the glacis while fire from the angled flanks enfiladed any section of the ditch. As shown in Fig. 1, the principal parts of a bastion were the salient angle *a*, the faces *b*, and the flanks *c*.

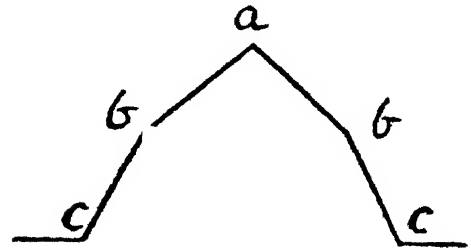
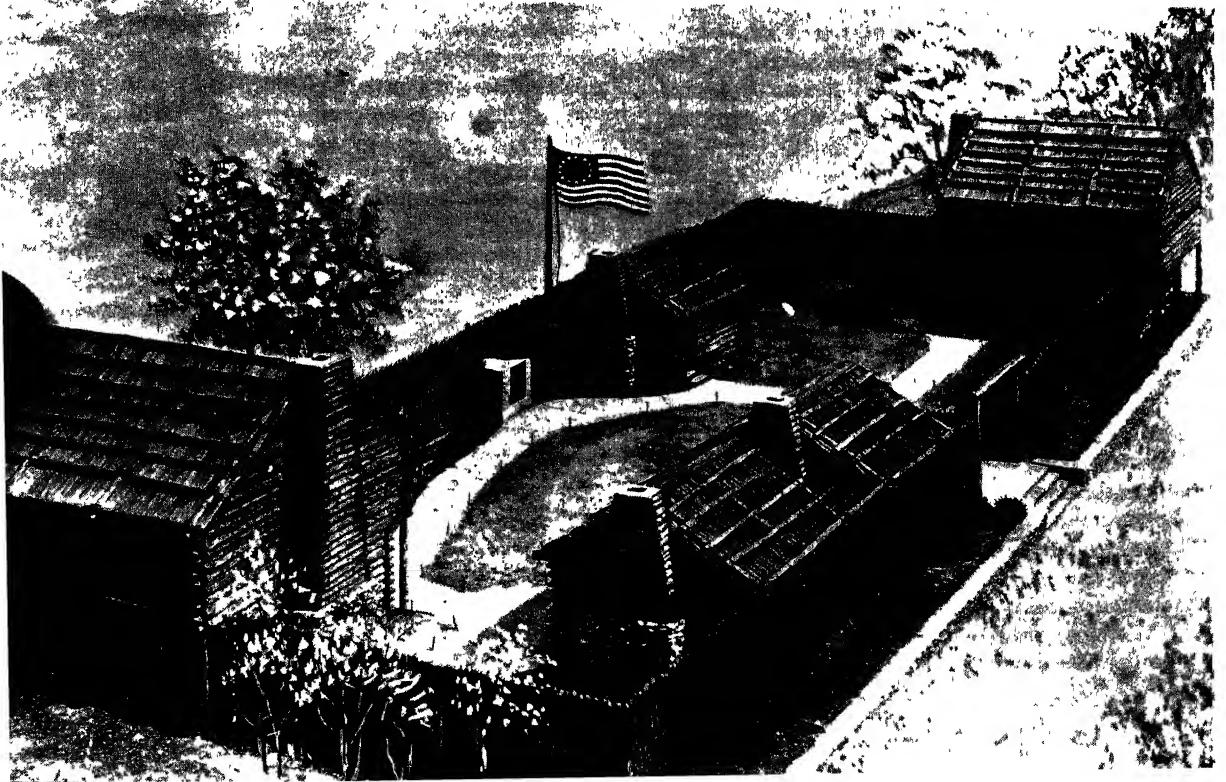


Fig. 1

A replica of Fort Nashborough on the site of the original structure in Nashville, Tenn. Built in 1780, it was typical of the wooden fortifications of the American frontier. The buildings diagonally situated are defensive blockhouses

Nashville Chamber of Commerce

Vauban and the 18th Century. Fortification was developed into a systematized science by the French engineer Sébastien Le Prestre de Vauban (1633–1707), who, by his talents, rose from humble birth to be a marshal of France. Vauban



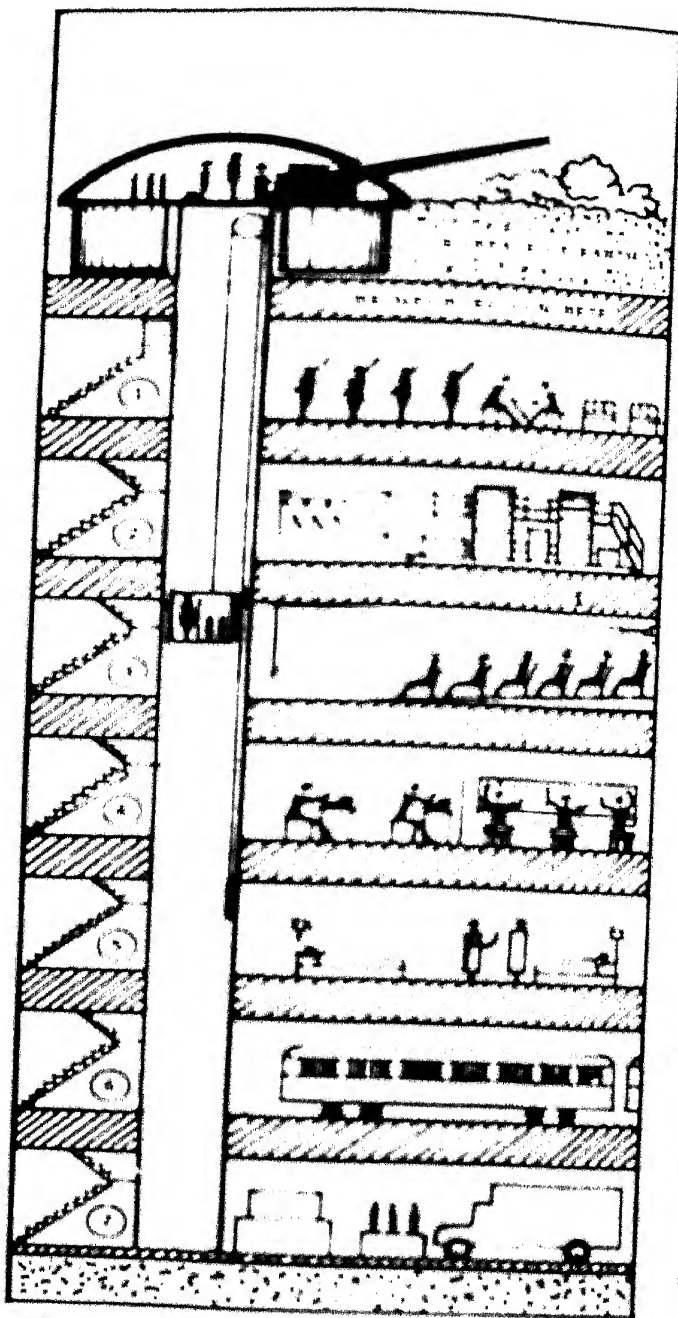
was a master not only of fortification, an art which his ideas were to influence for the next 150 years, but also of siegecraft. He developed the system of parallel approaches, which began with a trench parallel to the defenses and just out of range of the defending artillery. From this trench, zigzag approach trenches, angled so that the trenches could not be enfiladed by defending fire, were pushed forward and connected by a new parallel, from which a second system of zigzag trenches was advanced while the first parallel was developed into an artillery position. Finally the siege artillery was close enough to the rampart to concentrate its breaching fire against a selected point, while underground galleries were driven forward under the glacis and the rampart, and charged with gunpowder. The explosion of these mines usually completed a breach through which storming parties could gain the interior of the fortress. Vauban engineered more than forty successful sieges. A humane man, he developed an etiquette for siegecraft in which it became customary for the besieger, having breached the rampart, to summon the commander of the fortification to surrender; such surrender was considered no disgrace when further resistance would lead only to needless loss of life.

The durability of Vauban's influence may partly account for the relative lack of novelty in the development of fortification and siegecraft during the 18th century. At that time the French military engineer Marquis de Montalembert (1714–1800), deployed an immense volume of defensive artillery fire against the besieger's techniques. This defense was widely in use in France at the start of the Napoleonic era. The next really substantial change was brought about by weapons development following the industrial revolution (q.v.). Rifled artillery with longer range and greater accuracy, and explosive shells of greater destructive power demonstrated the vulnerability of existing permanent fortifications when the French cities of Metz, Sedan and Paris were taken during the Franco-German War (q.v.) of 1870–71. Field fortification, however, in association with the fire and movement of rifle-armed infantry, was beginning to come into its own, as the events of the American Civil War (1861–65) demonstrated; see CIVIL WAR, THE AMERICAN.

19th-Century American Fortification. The fortress of West Point (q.v.), N.Y., which had been a strategic pivot of operations during the American Revolution (q.v.), became the seat of a military academy which began developing the arts of fortification and siegecraft. Based on the

theories of Vauban, which had been brought to the United States by the American army officer Colonel Sylvanus Thayer (q.v.) in 1817, the American approach to fortification envisaged harbor defense as the principal function of permanent works. Field fortifications were developed for use in mobile situations. The muzzle-loading Springfield rifle, which was just coming into use in 1861, when used with the minie bullet, was far more formidable both in shock power and range than any infantry weapon previously known. Infantry armed with these weapons could make use of field fortification to establish a pivot of maneuver with a comparatively small proportion of the available infantry strength, while a high proportion could be used for the maneuver force. The early Confederate victories in Virginia, including the Battle of Chancellorsville (see CHANCELLORSVILLE, BATTLE OF), owed a good deal to the daring application by General Robert Edward Lee (see *under* LEE) of this tactical device. When a running battle came to a standstill as at the siege of Vicksburg (see VICKSBURG, CAMPAIGN OF), in 1863 or Petersburg (q.v.) in 1864, field works showed the same tendency as in the later experience of World War I to develop into semipermanent fortifications. The permanent harbor fortifications in the zone of operations played a relatively minor part in the American Civil War. The seaward defenses of several southern ports were reduced by amphibious operations of the Union troops.

World War I. The stabilized situation of the Western Front in Europe during World War I had its strategic origin in a relatively short front with no open flanks. Tactically, the enormously increased volume of fire of automatic rifles and machine guns gave a decisive advantage to defending infantry, protected by field works and barbed wire obstacles. The opposing armies quite literally sank into the earth, where a sufficient proportion of defending fire power could always manage to survive to repel an assault by infantry advancing over open ground. After a three year bloody deadlock, it seemed that the ideal of the fortifier's art, the impregnable fortress, had been attained. The deadlock was broken only when armored vehicles, combining fire power and mobility with protection, came into use. World War I also saw the beginnings of air warfare, which was chiefly of value at this time for reconnaissance and in the direction and adjustment of artillery fire. These qualities emphasized the value of concealment and deception, and added scientific camouflage (q.v.) as an essential element of the art of fortification.



A plan of the subterranean chambers of a fort along the Maginot line. (1) Troop quarters, (2) Ventilating and lighting equipment, (3) Asphyxiators, (4) Administration and telephone wires, (5) Hospital, (6) Main road connecting with other forts, (7) Garage and ammunition storage.

Initially, permanent fortifications in France and Belgium proved of value chiefly in delaying actions, though such works were later incorporated, as at Verdun, into general schemes of defense. On the Russian front and in the Middle Eastern campaigns, the importance of fortification was proportionately reduced by space, and

a war of movement prevailed. The principal amphibious campaign of World War I, on the Gallipoli peninsula in Turkey, was so consistently mismanaged by the British that the lessons to be derived from it are chiefly negative; see GALLIPOLI AND DARDANELLES CAMPAIGN. See also SOMME, BATTLES OF THE.

World War II. Air power was in its adolescence until the start of World War II (q.v.), when the German dictator Adolph Hitler (q.v.) conducted blitz campaigns in Poland and Western Europe, in which air and surface mobility and striking power were skillfully combined. The campaigns made the elaborate French permanent fortifications of the Maginot Line the symbol of military futility throughout the world. The Maginot Line, extending about 200 mi. along the eastern border of France, was designed to prevent a frontal assault; the Germans invaded France in 1940 by flanking the line. The spectacular success of the German airborne assault on the Greek island of Crete seemed, for a time, to confirm the verdict that fortification was a dead art. Yet as the German campaign against the Soviet Union developed, the old Russian formula of trading space for time to mobilize the full scale of Russian resources, the strategy which had defeated Napoleon I (q.v.), Emperor of France in 1812, eventually checked the German invasion and caused it to recoil into a series of fortified positions along a front from the Baltic Sea to the Black Sea. At both extremes of this front, stabilized siege situations developed, around Leningrad in the north and Stalingrad (now Volgograd) in the south, which, in their demands on human endurance and sacrifice, were similar to the sieges of earlier wars. The raising of the siege of Stalingrad by Soviet counterattack became the historical symbol of the German defeat; see STALINGRAD: *The Battle of Stalingrad*.

In the west, the German reliance on the so-called Atlantic wall proved futile when their defenses were breached by amphibious assault in Normandy, France. Strong German defense of Channel ports to deny the Allies logistic access to the theater of operations only delayed the outcome; in the Italian campaign, the defense of Monte Cassino (q.v.) was prolonged, but was finally overwhelmed.

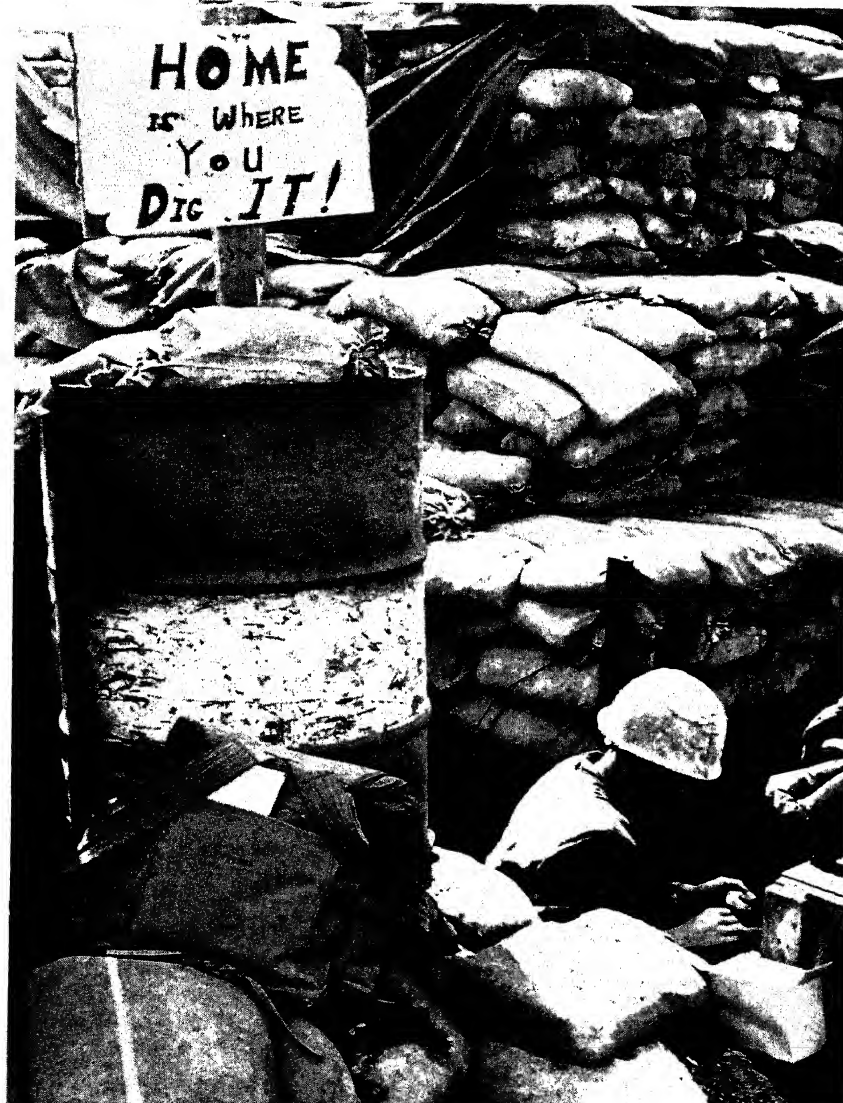
In the Pacific campaign, the Japanese surprise raid on Pearl Harbor (q.v.) emphasized the new vulnerability of seaward defenses against air attack, a lesson which was to be repeated later at Singapore. The operations in the Pacific theater which followed were the most extensive amphibious campaigns in the history of warfare; in



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U.S. Army

Above: A foxhole of World War II. The canvas cover is half of an army shelter tent, used here to protect men as well as equipment from rain and to provide camouflage against aerial reconnaissance. Right: A trench surrounded by sandbags affords protection for an American soldier under fire in Vietnam.



FORT JAY

several cases the amphibious phase was followed by land and air operations against Japanese fortified positions, the most extensive of these being on the island of Okinawa. During the reconquest of the Philippine Islands in 1945, the desperate Japanese defense of the built-up section of the chief seaport, Manila (q.v.), involved house-to-house fighting similar to that in Stalingrad.

Recent Developments. Two features of recent siege warfare are the extensive use of land mines and of a variety of booby traps. The Korean War (1950–53) began with the U.S. defense of the so-called Pusan perimeter, about 50 mi. from the seaport of Pusan (q.v.), in which local field fortifications were a prominent feature; the defense was followed by a combined land and amphibious counteroffensive which took the United Nations forces all the way to the Yalu R., only to be rolled back by a massive Chinese intervention. The tide of war moved south, then north again, and finally became stabilized north of the 38th parallel where the Chinese and North Koreans developed a massively fortified front across the Korean peninsula which is still the borderline between North and South Korea. As in the ancient wars of Asia, extensive use was made of impressed Korean manpower in fortifying and supplying this front; see *KOREA History*; *KOREAN WAR*.

The practice of massive manpower was a feature of the war in Vietnam, where the availability of great civilian manpower enabled the North Vietnamese to effect speedy repairs to air-damaged bridges and railways. In South Vietnam, the almost incredible extent of tunneling and underground excavation by the Vietcong, coupled with a talent for concealment, was a notable adjunct to their field-fortification techniques. G.F.E.

FORT JAY. See *GOVERNORS ISLAND*.

FORT JEFFERSON NATIONAL MONUMENT, historic area in Florida on Garden Key of the Dry Tortugas, containing Fort Jefferson, built in 1846, the largest masonry fortification in the Western Hemisphere. During and after the American Civil War, it served as a Federal military prison. Samuel Alexander Mudd (1833–83), the physician who set the broken leg of John Wilkes Booth (see *under* **BOOTH**) following the assassination of President Abraham Lincoln (q.v.), was a prisoner at Fort Jefferson until 1869. Surrounded by a wide, shark-infested moat, the prison was popularly known as Shark Island. The monument, covering 47,125 acres, was established in 1935. It is administered by the National Park Service (q.v.).

FORT KNOX, American military post and reservation in Hardin County, Ky., about 30 miles sw of Louisville and covering an area of about 33,000 acres. It was established in 1918 and named in honor of Henry Knox (q.v.), a general in the American Revolution (q.v.) and the first secretary of war. Fort Knox contains the Armored School, a training center for the armored units of the United States Army. The reservation is also the site of the Patton Museum, named after the American general George Smith Patton (q.v.). The museum contains a collection of German vehicles, weapons, and other military articles dating from World War II (q.v.). The greater part of the gold reserve of the United States government is stored at Fort Knox in the U.S. Gold Depository, a fortified building completed in 1937. The gold is kept in a steel and concrete vault beneath the building. This underground chamber is 60 ft. long and 40 ft. wide, resting on solid rock, with walls over 2 ft. thick. Many modern scientific devices protect the vault.

FORT-LAMY, former name of N'DJAMENA, city and capital of the Republic of Chad, and capital of Shari-Beguirmi Prefecture, on the Shari R. at the Cameroon border, about 930 miles N.E. of Lagos, Nigeria. N'Djamena is the major trade center of Chad and has an international airport. Livestock, hides, cotton, grain, dates, and salt are exported to the south by road and river and to the north by caravan. Industries include vegetable-oil milling, food processing, metalworking, and the manufacture of cotton textiles, pottery, and brick. N'Djamena is the site of the University of Chad and a college of administration. Founded by the French as a military base in 1900, the city was made the capital of the Chad colony of French Equatorial Africa in 1920. Pop. (1972 est.) 166,500.

FORT LARAMIE NATIONAL HISTORIC SITE, historic area in Wyoming, near the confluence of the Laramie and North Platte rivers, 2 mi. from the town of Fort Laramie. The site preserves the remains of Fort Laramie, built in 1834 as a trading post by the American soldier and fur trader William Lewis Sublette (1799?–1845) and established as a military post in 1849. It was a famous outpost during the days of western expansion, a rendezvous for such historic figures as Kit Carson (see *CARSON, CHRISTOPHER*) and "Buffalo Bill" Cody (see *CODY, WILLIAM FREDERICK*). It was also an important station on the old Oregon Trail (q.v.). The troops stationed at Fort Laramie patrolled wide areas of the West to protect covered-wagon trains from hostile Indians. In 1890 the fort was abandoned, and the surrounding

FORT McHENRY NATIONAL MONUMENT

land was opened to homesteaders. The site is administered by the National Park Service (q.v.). **FORT LARNED NATIONAL HISTORIC SITE**, historic area in Kansas, near Larned, 99 miles N.W. of Wichita, an outstanding example of an original frontier military station. It was one of the most important posts in Kansas on the Santa Fe Trail (q.v.), and during the Indian wars the trail was protected by the garrison at the fort. The nine sandstone buildings on the site date from the period of the fort's occupancy (1859–82). It is administered by the National Park Service (q.v.).

FORT LAUDERDALE, city in Florida, and county seat of Broward Co. on the North New River Canal and the Atlantic Ocean, 26 miles N. of Miami. It is served by railroads, transoceanic vessels, and steamers on the Intracoastal Waterway and the North New River Canal. The harbor of the city, Port Everglades, is one of the deepest on the S. Atlantic Coast. Fort Lauderdale is the commercial center of a region producing citrus fruits, truck vegetables, and dairy products. The city contains large warehouses and oil-storage tanks. A leading industry in Fort Lauderdale is fishing. The city is also an important vacation resort and the site of the annual Collegiate Aquatic Forum. It has a yacht basin, and facilities for surf bathing and inland and deep-sea fishing. A United States Coast Guard base is maintained at Fort Lauderdale. The Everglades (q.v.) lie approximately 40 mi. away and a Seminole Indian Reservation is nearby. It is the site of Junior College of Broward County and Nova University. The city grew up around a fort established in 1838 during the Seminole Wars (q.v.), and was incorporated in 1911. The city has grown rapidly since the end of World War II; its 1950 population of 36,328 increased to 83,648 in 1960, and in 1970 it was 139,590.

FORT LEE, borough of New Jersey, in Bergen Co., on the Palisades (q.v.), overlooking the Hudson R., and opposite the N. part of Manhattan Island. It is the W. terminus of the George Washington Bridge (q.v.) across the Hudson. Fort Lee was a center of the early motion-picture industry, but is now chiefly a residential suburb. The Palisades Interstate Park is situated N. of the borough. Fort Lee was named for the fortifications erected there early in the American Revolution (q.v.), and named after the British-American general Charles Lee (see under LEE). Together with Fort Washington on Manhattan Island, it was built to defend the important fort at West Point (q.v.) from the British. After the capture of Fort Washington by the British in November, 1776, the American forces aban-

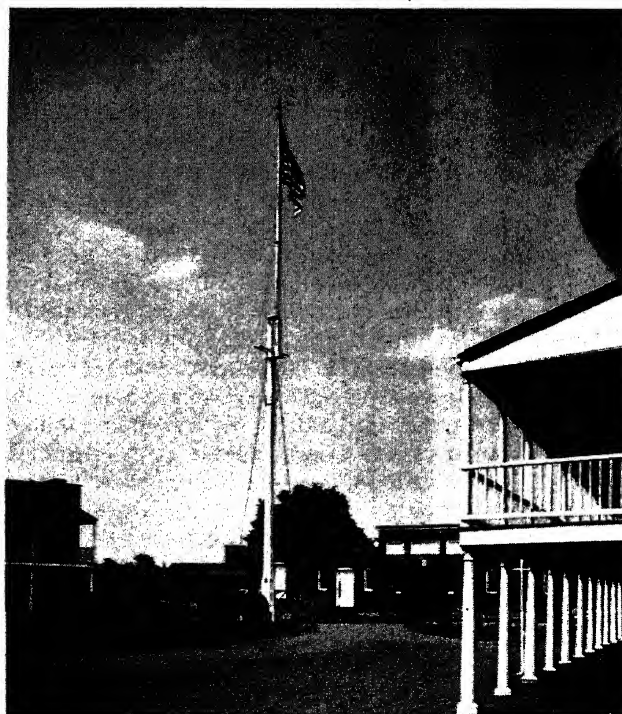
doned hope of holding the fort, and retreated to join General George Washington (q.v.) in the American retreat across New Jersey. A monument, erected in 1908, marks the site of the old stronghold. The borough of Fort Lee was incorporated in 1904. Pop. (1960) 21,815; (1970) 30,631.

FORT MADISON, city in Iowa, and county seat of Lee Co., on the Mississippi R., about 16 miles S.W. of Burlington. The city has varied manufactures. Fort Madison is a commercial and rail center for the area. Pop. (1960) 15,247; (1970) 13,996.

FORT MATANZAS NATIONAL MONUMENT, historic fort in Florida, on Rattlesnake Island, at the mouth of the Matanzas R., about 15 miles S.E. of Saint Augustine, which it was built to protect. Standing 30 ft. high, the fort was constructed of coquina, a soft whitish limestone mixture of broken shells and coral. Near the site of the fort in 1565, the Spanish explorer and founder of St. Augustine, Pedro Menéndez de Avilés (1519–74), massacred about 300 French Huguenot settlers. The fort was ceded by Spain to Great Britain in 1763 and was acquired by the United States in 1821. It is administered by the National Park Service (q.v.).

FORT McHENRY NATIONAL MONUMENT AND HISTORIC SHRINE, historic site in Maryland, on the Patapsco R., at the entrance to the upper harbor of Baltimore, preserving historic Fort McHenry, which has been restored

*Fort McHenry National Monument in Baltimore, Md.
Chamber of Commerce of Metropolitan Baltimore*



FORT MIMS, MASSACRE OF

and outfitted with replicas of furniture and articles in use during its era of military importance. The fort, erected in 1794, was named after James McHenry (1753–1816), a Revolutionary patriot and United States secretary of war from 1796 to 1800. On Sept. 13–14, 1814, during the War of 1812 (q.v.), the fort successfully withstood a 25-hour bombardment by the British fleet under Sir George Cockburn (1772–1853). The sight of this bombardment, and of the American flag still waving over the fort after the firing had ceased, inspired Francis Scott Key (q.v.) to write "The Star Spangled Banner". It is administered by the National Park Service (q.v.).

FORT MIMS, MASSACRE OF, massacre of settlers in Alabama on Aug. 30, 1813, during the Creek Indian uprising. The settlers, numbering 553 men, women, and children, gathered for protection within a temporary stockade near the junction of the Alabama and Tombigbee rivers, 35 miles north of Mobile. A greatly superior force of Creek, commanded by William Weatherford ("Red Eagle"; about 1780–1824), surprised the garrison and slaughtered all within the stockade with the exception of a few Negroes and half-breeds who were taken prisoner; fifteen white settlers escaped. A monument now marks the site of the stockade.

FORT MYERS, city in Florida, county seat of Lee Co., on the Caloosahatchee R., about 15 mi. from the Gulf of Mexico, and 95 miles s.e. of Tampa. It is a center for growing and shipping gladioli. Other industries include boatbuilding, vegetable and citrus-fruit processing, shrimp fishing, and the manufacture of electronic products. Sometimes called the "City of Palms", Fort Myers has been a resort center since the 1920's, with beaches on the coast and offshore islands. Retirement communities have developed here in recent years. The city is the site of Edison Junior College and the Edison Home, the winter residence of the inventor Thomas Alva Edison (q.v.). In the vicinity are the Tropical Gardens and the Florida Marine Museum and Shell Factory. The city developed around a fort built in 1841 during the Seminole War. Pop. (1960) 22,523; (1970) 27,351.

FORT NECESSITY NATIONAL BATTLEFIELD, historic area in s.w. Pennsylvania, where on July 3, 1754, the first battle of the French and Indian War (q.v.) was fought. Known as the Battle of Great Meadows, the encounter marked the first major event in the military career of George Washington (q.v.) and his only surrender. He and his small company returned to Virginia and the fort was destroyed by the French. The grave of the British general Edward Braddock (q.v.) is

1 mile w. of the fort on the battlefield. It is administered by the National Park Service (q.v.). **FORT PIERCE**, city in Florida, and county seat of Saint Lucie Co., on the Indian River, 55 miles n.w. of Palm Beach. It is a fishing resort and port, connected with the Atlantic Ocean by Fort Pierce Inlet. The city has large canneries and food-processing plants and is a major shipping center for vegetables and citrus fruits. Manufactures include wood and concrete products, lumber, and fertilizer. Fort Pierce is the site of Indian River and Lincoln junior colleges. The city, which grew up around a fort established in 1838, was incorporated in 1909. Pop. (1960) 25,256; (1970) 29,721.

FORT PILLOW, fort in Tennessee, on the E. bank of the Mississippi R., about 40 miles N. of Memphis, noted as the site of the so-called Massacre of Fort Pillow during the Civil War; see CIVIL WAR, THE AMERICAN. The fort was constructed by Confederate forces under the direction of General Gideon Johnson Pillow (1806–78) in the spring of 1862, but was abandoned by them on June 4 of the same year. A small Federal force occupied the fort on June 5, and it remained in their possession, lightly garrisoned, until April 12, 1864, when it was reinforced by about 500 men, a majority of them Negroes. On that day, Fort Pillow was attacked by a strong Confederate force under Nathan Bedford Forrest (q.v.). After offering a stubborn resistance, prolonged even when capture had become inevitable, the garrison was overpowered. The Confederates were accused by the United States War Department of deliberately massacring more than 300 Negro soldiers in the fort after the surrender. Only about 160 white and 40 Negro prisoners were taken.

FORT PULASKI NATIONAL MONUMENT, historic fort area in Georgia occupying Cockspur and McQueens islands, at the mouth of the Savannah R., about 15 miles E. of Savannah. Fort Pulaski, an enclosed brickwork fortification, was built on Cockspur Island, between 1829 and 1847 and named in honor of the Polish count Casimir Pulaski (q.v.), a hero of the American Revolution. Seized and garrisoned by the Confederates at the outbreak of the American Civil War (see CIVIL WAR, THE AMERICAN), the fort was bombarded by a Union force for twenty-nine hours on April 10–11, 1862. The fort was extensively damaged and the Confederates were forced to surrender. Rifled cannon, used for the first time in combat, demonstrated the ineffectiveness of brick and masonry forts. With the fall of Fort Pulaski the Savannah R. was closed to blockade runners. The fort, with walls from 7 ft.

to 11 ft. thick and 32 ft. high, is surrounded by a moat traversed by drawbridges. Shells fired by the Union forces during the siege are still embedded in the walls of the fort. The monument, covering 5516.62 acres, was established in 1924. It is administered by the National Park Service (q.v.).

FORT RALEIGH NATIONAL HISTORIC SITE.

See ROANOKE ISLAND.

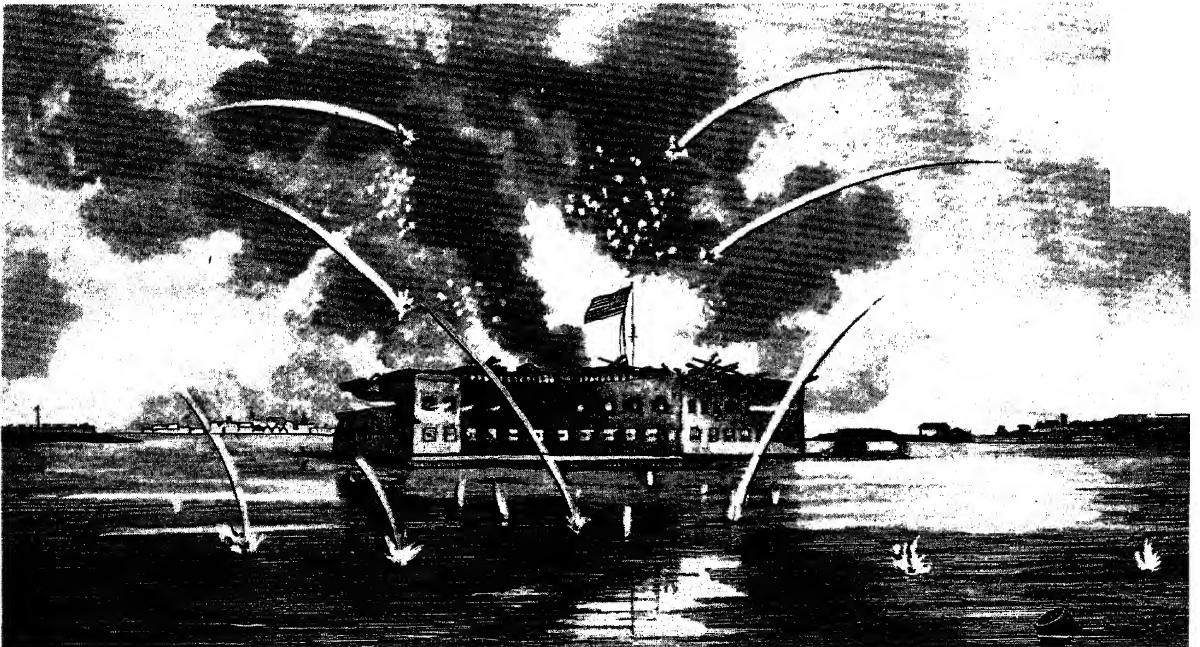
FORTRESS. See FORTIFICATION AND SIEGECRAFT.

FORT SMITH, city in Arkansas, and county seat of Sebastian Co., at the confluence of the Arkansas and Poteau rivers, about 165 miles N.W. of Little Rock and near the border with Oklahoma. The city is served by several railroads. It is the commercial center of a rich agricultural area embracing two counties in Arkansas and two counties in Oklahoma, and the manufacturing center for the coal and natural-gas region of Arkansas. Industrial establishments in Fort Smith are railroad shops, cotton compresses, smelters, woodworking shops, brickworks, and factories manufacturing glass, furniture, metal articles, and automobile bodies. In addition, the city has extensive wholesale and retail houses and is one of the largest mule markets in the United States. It is the site of Fort Smith Junior College, established in 1928, Fort Smith National Cemetery, established in 1887, and Fort Smith National Historic Site, established in 1964; see NATIONAL PARK SERVICE. French traders in the 18th century called the site of the present city Belle Pointe. In 1817 a United States military post was erected on the site to protect the settlers from the Osage and Cherokee Indians. It was named Fort Smith in honor of General Thomas A. Smith. The settlement that grew up around the fort was incorpo-

rated as a town in 1842 and chartered as a city in 1845. The sympathies of the inhabitants were with the Confederacy during the Civil War, and the fort was seized by them in April, 1861. In September, 1863, Federal forces reoccupied the fort, which was finally abandoned in 1871; see CIVIL WAR, THE AMERICAN. Pop. (1960) 52,991; (1970) 62,802.

FORT SUMTER, historic fort in South Carolina, on an artificial island at the entrance to the harbor of Charleston, and about 3 mi. from that city. It is famous as the scene of the first act of war in the Civil War; see CIVIL WAR, THE AMERICAN. Construction of Fort Sumter was begun about 1830, but in 1860 the fort was still unfinished and was not garrisoned. On Nov. 21, 1860, Major Robert Anderson (q.v.) of the Union army took charge as commander of the three forts—Fort Moultrie, Fort Sumter, and Castle Pinckney—in Charleston Harbor. He occupied Fort Moultrie but, following the passing of the ordinance of secession by South Carolina on Dec. 20, 1860, Anderson realized that Fort Moultrie could not be defended against land attack, and removed his small garrison secretly on the evening of Dec. 26 to Fort Sumter farther from shore. Governor Francis Wilkinson Pickens (1805–69) of South Carolina, seizing Fort Moultrie and other fortifications closer to shore, demanded the surrender of Fort Sumter, which Anderson refused. An attempt was made on Jan. 9, 1861, by a Union merchant vessel, *Star of the West*, to land supplies and reinforcements for Fort Sumter, but the vessel was fired upon from the mainland and was forced to withdraw. With

Bombardment of Fort Sumter.



FORT THOMAS

the garrison of the fort under state of siege negotiations were transferred to the Federal government in Washington, D.C. On April 8, President Abraham Lincoln (q.v.) notified Pickens that an attempt would be made to send provisions only to Fort Sumter, which was in danger of being starved out. On April 11, however, General Pierre Gustave Toutant de Beauregard (q.v.), acting on the orders of Jefferson Davis (q.v.), President of the Confederate States of America (q.v.), again demanded the evacuation of the fort. Anderson again refused, but with the stipulation that if he did not receive provisions or controlling instructions from the Federal government by noon on April 15, he would abandon the fort. This answer proved unsatisfactory to the Confederate authorities, and at 4:30 A.M. on April 12, Fort Johnson in Charleston fired the first shot of the bombardment, thereby ending all negotiations and marking the beginning of the Civil War. The relieving fleet sent by Lincoln arrived on the same day but, because of cannon fire from the shore-based batteries, was unable to enter the harbor. On April 14 Anderson and the garrison marched out of Fort Sumter with full honors of war, after having agreed upon surrender terms the preceding day. No casualties occurred during the bombardment.

After taking possession of Sumter, Confederate troops completed construction of the fort and greatly strengthened it. They held it in spite of several Union attacks by land and by sea in 1863, evacuating it finally on Feb. 17, 1865, with the approach of the army of Union general William Tecumseh Sherman (q.v.). On April 14, 1865, by order of Secretary of War Edwin McMasters Stanton (q.v.), Anderson, now a general, raised over the fort the same flag which he had been forced to lower four years before. The site, covering 36.27 acres, is preserved as the Fort Sumter National Monument. Established in 1948, the monument is administered by the National Park Service (q.v.).

FORT THOMAS, city of Kentucky, in Campbell Co., about 4 miles S.E. of Covington. Primarily a residential area, the city manufactures balsa fishing floats, tool dies, and cut gems. It is the site of Fort Thomas Military Reservation, established in 1887. The city was incorporated in 1867. Pop. (1960) 14,896; (1970) 16,338.

FORTUNATE ISLANDS or **FORTUNATAE INSULAE**. See CANARY ISLANDS.

FORTUNE-TELLING, practice of predicting the future of individuals by divining the alleged significance of signs, such as the lines in the palm of a hand; see DIVINATION; PALMISTRY. Other forms of fortune-telling, in addition to palmis-

try, include astrology (q.v.); cartomancy, the practice of foretelling coming events by means of playing cards; and necromancy, the practice of divining the future through consultation with the spirits of the dead. Clairvoyance (q.v.), the perception of past, present, and future events by extrasensory means, and prophecy, as a manifestation of religious exaltation, are not considered forms of fortune-telling.

Although fortune-telling is without basis in scientific fact and is contrary to prevailing conceptions of physical science and philosophy (see DETERMINISM; RATIONALISM), it is popular in many countries, including the United States. In ancient times fortune-telling was virtually a universal practice. The governments of Rome and of other nations of antiquity appointed official fortune-tellers whose talents were invoked before important state and personal decisions were made. History and literature abound with instances of the influence exercised by fortune-tellers on monarchs and persons of importance.

The British Vagrancy Act of 1824 provided for the imprisonment of fortune-tellers. In the U.S. professional fortune-tellers are within the statutory definition of disorderly persons and are subject to punishment for committing a misdemeanor.

FORT UNION NATIONAL MONUMENT, historic site in New Mexico, about 60 miles N.E. of Santa Fe, site of the largest military post on the S.W. frontier in the 19th century. Erected in 1851 near the fork of the Santa Fe Trail (q.v.), the fort provided protection for travelers and neighboring settlers, and supplies for outlying posts; it also served as a base of operations for forays against hostile Indians. Ruins of adobe buildings are on the fort, which was abandoned in 1891. It is administered by the National Park Service (q.v.).

FORT VANCOUVER NATIONAL HISTORIC SITE, area of historic interest in Washington, where the present city of Vancouver now stands. The fort, built in 1825, was the western headquarters of the vast fur-trading empire of the Hudson's Bay Company (q.v.). Around it revolved the political, social, cultural, and economic activities of the Pacific Northwest. The Treaty of 1846, establishing the S. boundary of Canada, placed Fort Vancouver in American territory. In 1849 it became the first United States military post in the Pacific Northwest. It is administered by the National Park Service (q.v.).

FORT WALTON BEACH, city of Florida, in Okaloosa Co., on the Gulf of Mexico, about 37 miles E. of Pensacola. The city is primarily a resort and residential community, and has light

manufacturing. Nearby is Eglin Air Force Base. Pop. (1960) 12,147; (1970) 19,994.

FORT WAYNE, city in Indiana, and county seat of Allen Co., on the Maumee R. at the mouth of the Saint Joseph and Saint Marys rivers, about 100 miles N.E. of Indianapolis. It is the third-largest city in the State, and the commercial and manufacturing center of a fertile agricultural region. The varied industries in the city include the manufacture of gasoline tanks and pumps, electrical machinery and supplies, plumbing supplies, agricultural machinery, and automotive equipment. Fort Wayne is the site of Concordia Senior College, established in 1939, and Indiana Institute of Technology, established in 1930. Museums in Fort Wayne include the Lincoln Museum of the Lincoln Historical Research Foundation, and a museum of local history maintained by the county and housed in the old Swinney Homestead, built in 1845. The grave of the American pioneer Johnny Appleseed (q.v.) is in Fort Wayne.

The city is on the site of Kekionaga, the principal village of the Miami Indians. The Revolutionary general Anthony Wayne (q.v.) built a fort here in 1794 and Old Fort Park now marks the site. A settlement arose around the fort in 1815, and the fort itself was abandoned in 1819. Fort Wayne was incorporated as a town in 1829 and as a city in 1840. Pop. (1960) 161,776; (1970) 177,671.

FORT WILLIAM. See THUNDER BAY.

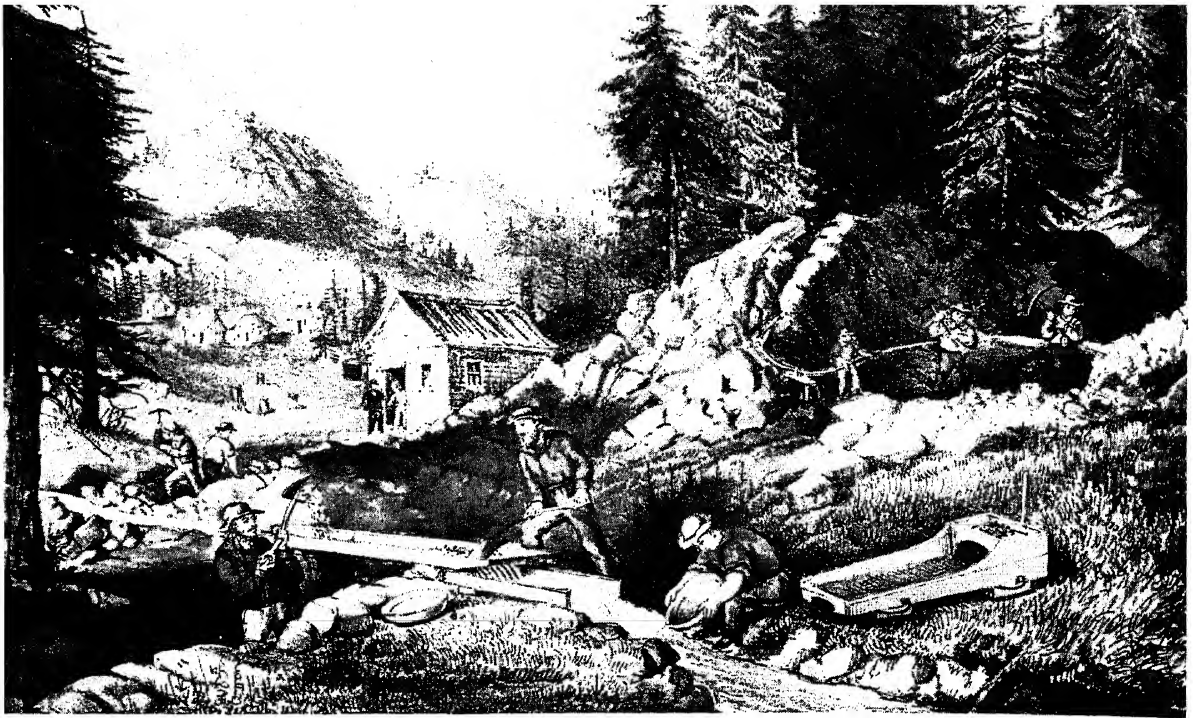
FORT WORTH, city in Texas, and county seat of Tarrant Co., on the Trinity R., at the confluence of Clear Fork and West Fork rivers, 30 miles w. of Dallas. It is the port of entry for the county and the fourth-largest city in the State. In addition Fort Worth is important as one of the largest sheep markets in the United States, the most important meat-packing center and grain and cattle market in the South and Southwest, and the greatest railroad center of the Southwest. Fort Worth is surrounded by a rich stock-raising, farming, and oil-producing area. Industrial establishments in the city include large stockyards, grain elevators and mills handling three fourths of the Texas wheat crop, oil refineries, meat-packing plants, railroad repair and construction shops, cottonseed-oil mills, foundries, machine shops, and factories manufacturing chemicals, automobiles, and aircraft.

Fort Worth is the site of Texas Christian University (q.v.) and Texas Wesleyan College (1890). Cultural and recreational facilities include a civic center, several art museums, botanic gardens, a zoo, and forty-seven parks, covering an area of more than 10,400 acres. On the outskirts

of the city are lakes Worth, Bridgeport, and Eagle Mountain, formed by three dams across the West Fork of the Trinity R., and covering a combined water area of more than 40 sq.mi.

Fort Worth grew up around a military post established on the site in 1849 to protect the scattered settlers of the region from Indian raids. It was named for William Jenkins Worth (1794-1849), a Mexican War general. The settlement became the county seat in 1860, and was incorporated as a city in 1873. Its actual growth dates from 1876, with the extension of the Texas and Pacific Railroad to the city. During World War II Fort Worth again experienced a rapid growth with the establishment of numerous wartime industries and military installations. Pop. (1960) 356,268; (1970) 393,476.

FORTY-NINERS, name popularly applied to the gold hunters, also known as the Argonauts of '49, who traveled to California in the period immediately following the discovery of gold in January, 1848. The discovery of gold at Sutter's Mill (see SUTTER, JOHN AUGUSTUS) by the American pioneer James Wilson Marshall (1810-85) caused great excitement in California (q.v.). Many people living near Sutter's rushed to the area of discovery to stake their claims. News of the gold strike traveled fast, and in December, 1848, President James Knox Polk (q.v.) delivered a message to Congress in which he mentioned the possibility of untold wealth in California. As a result, the gold fever spread throughout the United States and other parts of the world. Emigrants from Europe, Asia, and South America joined the Americans who made their way to California. Many people, following the water route, traveled by ship around Cape Horn, the southernmost point of South America. Others made their way overland across Central America by the Panama and Nicaragua routes, and across the plains of the U.S. by wagon train, all heading for the Mother Lode (q.v.) region of California. An estimated 100,000 people took part in the gold rush, the majority of them unmarried men from the eastern sections of the U.S. Most of them were anxious to make their stake and return East because life in California was rugged and often violent. In the mining camps lynch law often took the place of an orderly system of justice; see LYNCHING. The men lived in rough camps with such lurid names as Hell's Half Acre, Rough and Ready, and Hangtown. In the first year of the gold rush inadequate shelter, poor food, and lack of medical supplies resulted in the death of about 10,000 persons from dysentery and other diseases. Criminals also contributed to the disorder. Eventually, however, law-



Forty-niners mining gold in California. Ore dug from a vein was separated from dirt by a wash in a diverted stream. The heavy gold nuggets sank to the bottom of the sieve and were caught in flat pans (from a *Currier & Ives* print, 1871).

Library of Congress

enforcement agencies were established and the mining camps were brought under control. The majority of the forty-niners gained little benefit from their discoveries and the mines passed into other hands. The forty-niners have been a popular subject in American literature, a noted example being *Tales of the Argonauts*, published in 1875, by the American author (Francis) Bret Harte (q.v.).

See Gold: *Gold Production*.

FORUM (Lat., "marketplace" or "out-of-doors place"), term applied by the ancient Romans to the large, open, rectangular space in the central part of a city which was the common place of assembly of the people. Originally an unenclosed space, without buildings, in which the people gathered on market days and for religious festivals, elections, and other public events, it became the political center where civic and administrative buildings and the more important temples were located. Archways frequently surmounted both ends of the road or roads which transected the forum.

In early times, each city had only one forum serving not only as a place for the transaction of legal, political, and mercantile business, but also as an arena for public games, amusements, theatrical performances, gladiatorial and boxing combats, and races; see AMPHITHEATER. The principal forum in Rome, the Forum Romanum

Magnum ("Great Roman Forum"), was of this type, and above the colonnades which surrounded it were galleries for spectators. As cities grew, however, it became necessary to establish a separate forum (civilium) for legal and administrative affairs, as well as mercantile forums (venalia), each devoted to the sale of an important commodity. Among the mercantile forums were the animal, vegetable, fish, grain, and wine markets. The shops were situated around the square of the mercantile forum, and often on streets leading to it. In addition to the open forums, some cities also had covered markets, such as the cloth exchange at Pompeii (q.v.). As the term forum gradually became synonymous with market, it was employed as a descriptive epithet in the names of many market towns, such as Forum Appii, Forum Julii and Forum Livii.

The temples of the forum often fulfilled more than a religious purpose. In Rome, the Temple of Concord was used by the Senate as a meeting place, and the Temple of Saturn served as the government treasury and housed the state financial records until it was replaced by the Tabularium. The center of the forum was usually so filled with statues, altars, arches, memorial columns, and other monuments that the transaction of business was seriously obstructed. As a result, a general clearing of the forum was ordered from time to time.

History of the Forum. The original Roman forum was between the Palatine and Capitoline hills and Quirinal Hill; see ROME: *Etruscan Rome*.

Before 500 B.C. the swampland was drained and established as a shop-lined marketplace. An area for town meetings was at the northwest corner. The beauty of the forum was considerably enhanced with the erection of the temples of Saturn, Castor and Pollux, and Concord. The first courthouse, the Basilica Porcia, was built in 184 B.C., followed by those of Aemilia, Sempronia, and Opimia. The basilicas (see BASILICA) gave to the forum a characteristic colonnaded appearance. In 54 B.C., to alleviate the great congestion of the Forum Romanum Magnum, the Roman general and statesman Gaius Julius Caesar (q.v.) began construction of a new, walled forum, in which the most important building was the new courthouse, the Basilica Julia. Near this new forum, about 20 B.C., the Roman emperor Augustus (q.v.) built a still larger forum containing his temple to Mars Ultor. There followed the forums of Emperor Vespasian (q.v.), surrounding a beautiful temple of peace; the forum begun by Emperor Domitian and completed by Emperor Marcus Cocceius Nerva (qq.v.), in which stood a temple sacred to Minerva (q.v.); and finally, the magnificent forum of Emperor Trajan (q.v.), enclosing the Basilica Ulpia, the column of Trajan, and the temple of Trajan, added later by Emperor Hadrian (q.v.). These five imperial forums communicated with the Forum Romanum Magnum in a continuous line which stretched to the north and east of it.

The Gothic invaders of Rome in the 5th century A.D. inflicted comparatively little damage

on the imperial forums; see GOTHs. *Visigoths*. By the 9th century, however, deterioration had become appreciable, and with the great fire of 1084, when the Norman adventurer Robert Guiscard (q.v.) captured the city, most of the old edifices were destroyed. Those buildings which remained standing and habitable were occupied as fortresses. During the Renaissance (q.v.), particularly in the 16th century, these buildings were dismantled for use in monuments elsewhere. The area was reduced to a desolate wasteland, on which only a few gaunt columns stood, and became known as the Campo Vaccino, or Cow Plain. Since the 19th century, excavation and restoration of the forum area have been carried on under scientific auspices.

FOSCOLO, Ugo, originally NICCOLÒ FOSCOLO, 19th-century Italian patriot and writer. See ITALIAN LITERATURE: 19th Century.

FOSDICK, Harry Emerson (1878-1969), clergyman, born in Buffalo, N.Y., and educated at Colgate University, Union Theological Seminary, and Columbia University. He was ordained a Baptist minister in 1903, held a pastorate at Montclair, N.J., from 1904 to 1915, and was professor of practical theology at Union Theological Seminary from 1915 to 1946. He held the pulpit of the First Presbyterian Church in New York City from 1918 to 1925, when he was forced to

Ruins of the original Roman forum, the center of civic, economic, and religious activities in ancient Rome.

UPI



resign because of a dispute with the conservative Fundamentalists; see FUNDAMENTALISM. Soon thereafter he became the founding pastor of the interdenominational Riverside Church, also in New York. He retired from the church in 1946 and became active in community relations. His sermons and books met with great popularity, and he became one of the best-known American clergymen. His more than forty books include *The Meaning of Prayer* (1915) and *On Being a Real Person* (1943). He also wrote an autobiography entitled *The Living of These Days* (1956).

FOSSE, Bob, in full ROBERT LOUIS FOSSE (1927–), American choreographer and stage and film director.

Born in Chicago, Ill., on June 23, 1927, the son of a vaudeville singer, Fosse studied ballet, acrobatics, and tap dancing as a boy. After graduation from high school (1945), he enlisted in the United States Navy and performed with entertainment units in the Pacific. Discharged in 1947, he studied acting in New York City, then became a dancer and eventually a star with touring companies of Broadway musical shows. In 1953 he sang and danced in *Kiss Me Kate* and other film musicals. The following year his career as a choreographer began in earnest when he staged the dances for *The Pajama Game* on Broadway and won the first of a series of Antoinette Perry (Tony) Awards. His imaginative dance sequences for *Damn Yankees* (1955) were equally admired. Among his later Broadway successes were *How To Succeed in Business Without Really Trying* (1961), *Sweet Charity* (1965), and *Pippin* (1972). He also directed the films *Cabaret* (1972), for which he won the 1973 best-director award of the Academy of Motion Picture Arts and Sciences, and *Lenny* (1974).

FOSSIL, in geology, term used to describe any direct evidence of an organism more than 10,000 years old. A fossil may consist of the original structure, such as a bone, in which the porous parts have been filled with minerals, as calcium carbonate or silica, deposited from ground water; this process protects the bone from penetration by air and makes it stonelike. A fossil may also be an original substance, such as wood, that has been replaced, a molecule at a time, by mineral matter. The term can further be applied to any residue of carbon that remains in the same form as the original organism, that probably underwent the process of distillation (q.v.); examples of this type include many fern fossils. Natural molds and casts that form when the hard parts of organisms are dissolved by ground water are also fossils; the resultant cavities, being

natural molds, are later filled by hardened sediment and form replicas, or casts, of the original. Other types of fossils include imprints, such as tracks and footprints; unaltered remains preserved in places like frozen soil, asphalt lakes, and peat bogs, examples of which are the mammoth and woolly rhinoceros (qq.v.) and insects trapped in the resin of an ancient conifer (q.v.) and hardened into what is now called amber (q.v.); and fossilized excrement, known as coprolites, often containing fish scales and other hard parts of animals that were devoured.

Since fossils show gradual evolutionary changes through time, they actually provide the most important basis for dividing geologic time. See CARBON; GEOLOGY; PALEONTOLOGY. K.A.C. **FOSTER, Stephen Collins** (1826–64), American songwriter, born in Lawrenceville, Pa. (now part of Pittsburgh), and educated at Jefferson College (now Washington and Jefferson College). He was almost entirely self-educated as a musician, and his musical talent developed early. His first published song was "Open the Lattice, Love" (1844). Some of his later songs, in-



Stephen Collins Foster (from an 1859 daguerreotype).
University of Pittsburgh

cluding "Oh! Susanna", were collected in *Songs of the Sable Harmonies* (1848). These early songs were written for various minstrel troupes (see MINSTREL SHOW), and many of the songs became widely popular and brought him fame. During the years 1850 to 1860 Foster wrote many of his best songs including "Camptown Races" (1850), "Old Folks at Home" (1851), "Massa's in de Cold, Cold Ground" (1852), "My Old Kentucky

UNCLE NED.

AS SUNG BY DE COLORED SOCIETY
IN GENERAL.

I once knew a darkey, and his name was Uncle Ned,
Oh he died long ago—long ago,
He had no hair on the top of his head,
De place where de wool ought to grow

CHORUS

Lay down de shovel and de hoe,
Hang up de fiddle and de bow,
For no more work for poor old Ned,
He's gone where de good darkies go.

His fingers were long like de cane in de brake,
And he had no eyes fur to see,
He had no teeth for to eat de hoe cake,
So he had to let de hoe cake be.

CHORUS

Lay down de shovel and de hoe,
Hang up de fiddle and de bow,
For no more work for poor old Ned,
He's gone where de good darkies go.

One cold frosty morning old Ned died
Oh de tears down massa's face run like de rain,
For he knew when Neil was laid in de ground,
He'd nebber see his like again

CHORUS

Lay down de shovel and de hoe,
Hang up de fiddle and de bow,
For no more work for poor old Ned,
He's gone where de good darkies go.

PRICE ONE CENT.

All the New Songs constantly on hand at One cent each.

Tenth and Race Sts., Philadelphia, Pa.

MASSA'S

IN THE

COLD GROUND.

'Round de mead we am a singing
De darkies go round a singing,
While de mocking bird is singing,
Happy as de day an' song;
Whar de is am a creeping,
O'er de grassy mound
Dar old massa am a sleeping,
In de cold, cold ground

Down in de cornfield,
Hear dat mournful sound,
All de darkies am a weeping,
Massa's in de cold cold ground.

When de Autumn leaves were falling,
When de days were cold,
'Twas hard to hear ole massa calling,
'Case he was so weak and old,
Now de orange tree am blooming
On de sandy shore
Now de summer days are coming
Massa nebber calls no more
Down in de cornfield, &c

Massa make de darkies love him,
'Case he was so kind
Now dey sadly weep above him
Mourning as he leave dem behind;
I cannot work before to-morrow,
'Case de tear-drops flow,
I try to drive away my sorrow,
Pickin' ou de old banjo,
Down in de cornfield &c.

A. W. AUNER'S
CARD & JOB PRINTING ROOMS
Tenth and Race Sts., Philadelphia, Pa.

Home" (1853), "Jeanie With the Light Brown Hair" (1854), and "Old Black Joe" (1860). Despite the income from his songs, Foster's intemperate habits, especially alcoholism, kept him in poverty. From 1861 he lived alone in New York City, and he died in the charity ward of Bellevue Hospital.

Foster's songs, for all of which he wrote the lyrics, are among the most popular ever written by an American. Uninfluenced by European music, they were largely based on the music of the Negro American. The songs are characterized by touching melodies and simple harmonies. Although the lyrics usually deal with life on Southern plantations before the American Civil War, the songs express fundamental human emotions. His total musical output consisted of more than 200 songs and instrumental works, many of which are still popular today. Foster's home has been preserved by the city of Pittsburgh, and the University of Pittsburgh houses an extensive collection of first editions of his songs and material relating to his life.

FOSTORIA, city of Ohio, on the Seneca Co., Hancock Co., and Wood Co. lines, about 40 miles s. of Toledo. The city is a marketing and shipping center. Manufactures include electrical equipment, and wood and metal products. Fostoria was chartered as a town in 1854 and incorporated as a city in 1888. Pop. (1960) 15,732; (1970) 16,037.

FOUCAULT, Jean Bernard Léon (1819–68), French physicist, born in Paris. He abandoned

The published lyrics of two Foster songs.

University of Pittsburgh

the study of medicine to do research in physics. He worked with the French physicist Armand Hippolyte Louis Fizeau (1819–96) in making determinations of the speed of light (q.v.). Foucault proved independently that the speed of light in air is greater than it is in water. In 1851 he gave a spectacular demonstration of the rotation of the earth by suspending a pendulum (q.v.) on a long wire from the dome of the Panthéon in Paris; the movement of the pendulum duplicated the rotation of the earth on its axis. Foucault was one of the first to show the existence of the eddy currents (q.v.) generated by magnetic fields, and he also devised a method of measuring the curvature of telescope mirrors. Among the other devices Foucault developed were a polarizing prism and the form of gyroscope that is the basis of the modern gyrocompass; see *GYROSCOPE: Applications of the Gyroscope*. In 1855 he was awarded the Copley Medal of the Royal Society, and in 1865 he was elected to the French Academy of Sciences.

FOUCHÉ, Joseph, Duc d'Otrante (1759–1820), French statesman, notable in history as the father of political espionage; see *ESPIONAGE*. He was born near Nantes and was educated for the priesthood but never took orders. He became involved in the political activities of the French Revolution (q.v.) and, in 1792, was elected a deputy from Nantes to the National Convention (q.v.). There he began a series of unprincipled

FOUCHÉ

intrigues which characterized his entire political life.

A Violent Extremist. A moderate in the convention at first, he later betrayed his political associates, the Girondists (q.v.), in 1793 and voted with the extremist majority, the Jacobins (q.v.), for the execution of King Louis XVI and his wife, Marie Antoinette (qq.v.). Later, as the representative of the Convention in the city of Lyon, Fouché suppressed counterrevolutionary opposition with unparalleled ferocity, executing (1793) more than 1600 persons. During this period, too, Fouché took an extreme position on political issues, extolling atheism and advocating seizure and distribution of the property of the rich.

Recalled to Paris in 1794, he was denounced in the convention for his terroristic excesses by the head of the French revolutionary government, Maximilien de Robespierre (q.v.). Because such denunciations were usually the prelude to arrest and execution, Fouché intrigued against Robespierre in the Jacobin Club, and secured his own election as president of the club. Plot and counterplot followed, ending in the overthrow (July 27, 1794, the ninth Thermidor by the French revolutionary calendar) and execution of Robespierre. Fouché's arrest was ordered but he went into hiding until an amnesty on Oct. 26, 1795, freed him from the danger of arrest and punishment.

After a three-year period of obscurity and poverty Fouché was made a police spy by *Vicomte Paul François Jean Nicolas de Barras* (q.v.), head of the Directory. Fouché's extraordinary talents for that occupation soon led to a series of favors and promotions, and in July, 1799, he was appointed minister of police of the French republic.

In that capacity he learned, in 1799, of the plan of *Napoléon Bonaparte*, later *Napoleon I* (q.v.), Emperor of France, to seize power, but Fouché neither arrested the conspirators, as was his duty, nor participated in their plot. On Nov. 9, 1799 (the eighteenth Brumaire), when Bonaparte moved to seize Versailles (q.v.), Fouché awaited the outcome in Paris. Then, learning from his agents of Bonaparte's success, he declared Paris on the side of the conqueror.

A Master of Intrigue. Fouché served as minister of police under Bonaparte, who regarded him for a time as indispensable. He kept watch on the thousands of enemies Bonaparte made, and perfected the first modern system of political espionage. Those upon whom his agents kept watch included Bonaparte's wife *Josephine de Beauharnais* (see under *BEAUHARNAIS*) and her

brothers; and, on their behalf, Fouché also kept Bonaparte under surveillance. In 1802, the latter abolished the ministry of police, compensating Fouché with a senatorship and allotting him a large pension. By adroit speculation on the French exchange, Fouché used his pension to accumulate a fortune. In 1808 he was made *Duc d'Otrante* as a reward for loyalty.

During the Napoleonic Wars (q.v.), Fouché was for a time acting minister of the interior. In 1809 he won Napoleon's esteem when he exceeded his authority to mobilize an army to repel an invasion by the British in the Netherlands. Fouché then entered into surreptitious peace negotiations with the British. When in 1810 these actions were discovered, he was dismissed from his post. In 1813, however, he was appointed to the post of governor of the Illyrian Provinces which France acquired from Austria in 1809 under the terms of the Treaty of Vienna.

Following Napoleon's abdication in 1814, Fouché attempted unsuccessfully to ingratiate himself with the government of *Louis XVIII* (q.v.), King of France. After Napoleon returned from exile on *Elba* (q.v.), Fouché again was appointed minister of police, but used his position to intrigue against Napoleon with the Austrian foreign minister *Prince Klemens von Metternich* (q.v.). After Napoleon's defeat at the Battle of Waterloo (see *WATERLOO, BATTLE OF*), Fouché personally received the abdication of the fallen emperor and then became head of the provisional government of France which succeeded Napoleon. He continued as minister of police under *Louis XVIII* for five months in 1815 but was compelled to resign. A law enacted in 1816, banning the people responsible for the death of *Louis XVI*, led to Fouché's exile, first to Prague and, finally, after a period of wandering in central Europe, to Trieste, where he died. Shortly before his death he burned all his papers except his memoirs which, as subsequently published, are regarded by historians as of dubious accuracy.

FOUCQUET, Jean. See *FOUQUET, JEAN*.

FOUL MARTEN. See *POLECAT*.

FOUNDATION. See *BUILDING CONSTRUCTION: Foundations*.

FOUNDATION, a nonprofit organization, with funds and program managed by its own trustees or directors, and established to maintain or aid social, educational, charitable, religious, or other activities serving the common welfare. Although some governmental agencies employ the word "foundation" in their titles, the term is generally regarded as applying only to non-governmental organizations. The majority of modern foundations in the United States

are incorporated under a State or Federal charter; others are created under trust agreements. The foundation work is carried on by its own staff or by outside organizations or individuals to whom grants of money are allocated for use in specific projects.

Philanthropic endowments and institutions have been known since ancient times. The Greek philosopher Plato (q.v.) bequeathed valuable land to his disciples so they could maintain his Academy (q.v.), and similarly, the Egyptian king Ptolemy I (*see under* PTOLEMY) founded and endowed the famed museum and library in Alexandria; *see* ALEXANDRIAN LIBRARY. During the Middle Ages (q.v.), religious orders made endowments to promote religious and social welfare projects. In 1701, the English clergyman Thomas Bray (q.v.) founded the Society for the Propagation of the Gospel in Foreign Parts, an extant institution that established libraries and churches in the American colonies. In 1790 the American statesman and scientist Benjamin Franklin (q.v.) bequeathed funds to be lent to "young, married artificers of good character". The bequest of the British mineralogist James Smithson (q.v.) was used by the Federal government to establish the Smithsonian Institution (q.v.) in 1846. The legacy of the Swedish inventor Alfred Bernhard Nobel (q.v.) has been used since 1901 to honor international achievements in the fields of literature, chemistry, physics, medicine and physiology, and peace, and, since 1969, economics; *see* NOBEL PRIZES. Similarly, the will of the American newspaper publisher Joseph Pulitzer (q.v.) provided annual gifts for distinguished American contributions to journalism, literature and drama, and music; *see* PULITZER PRIZES.

Most of the great American foundations, with endowments of millions of dollars, were created in the 19th and 20th centuries. Although foundations that were legally defined as charitable were not subject to taxation after the Federal income tax was established in 1913 and the Federal inheritance tax in 1916, there was not a great increase in numbers until World War II and the imposition of high war-induced taxes. Before 1910 the U.S. had eighteen foundations, only one of which had an endowment in excess of \$10,000,000. In the early 1970's, however, the Foundation Center estimated the number of foundations to be over 30,000. Of these, 331 had assets of \$10,000,000 or more. About one-third of the assets of all American foundations are concentrated in twelve, with the Ford Foundation (q.v.), the largest, reporting \$3,400,000,000 in 1972. The accumulated wealth of the founda-

tions and the tax abuses practiced by a few led to Federal restrictions on organizations classified as private foundations. In 1969 Congress established a 4 percent annual excise tax based on foundation investment income and required that the foundations annually spend all of their income for the purposes for which they were formed. By 1975 the payout requirement will be in the range of 6 percent of the market value of assets. In addition, limitations were set on foundation ownership of businesses and on political activity.

The ten largest foundations in the U.S. in 1973 were the Ford Foundation, Robert Wood Johnson Foundation, Lilly Endowment, Inc., Rockefeller Foundation, Kresge Foundation, Andrew W. Mellon Foundation, W. K. Kellogg Foundation, Duke Endowment, Pew Memorial Trust, and Charles Stewart Mott Foundation.

In contrast to the U.S., the scope and endowments of foundations in Canada are small. The functions of the Canadian foundations, most of which were established after 1940, are similar to the American institutions.

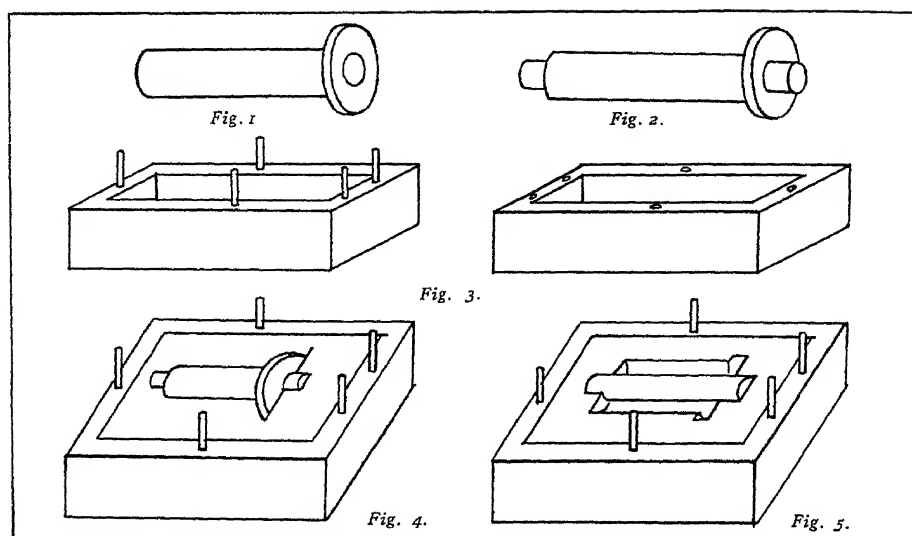
For further details on American foundations and philanthropists *see* CARNEGIE, ANDREW, and a series of articles under CARNEGIE; GUGGENHEIM MEMORIAL FOUNDATION, JOHN SIMON; HARKNESS, EDWARD STEPHEN; JUILLIARD SCHOOL OF MUSIC; PEABODY, GEORGE; ROSENWALD, JULIUS; RUSSELL SAGE FOUNDATION.

FOUNDING, process of producing metal objects, called castings, by pouring molten metal into a hollow mold, usually made of sand. The founding process itself is sometimes called casting. Founding is an ancient art, and is still used extensively, although it has been supplanted to some extent by other methods, such as die casting, forging (qq.v.), extrusion, machining, and rolling. *See* IRON AND STEEL MANUFACTURE; METALLURGY.

Founding involves three separate operations: first, making a wood or metal pattern intended as a replica of the finished object; a hollow mold is then made by packing sand around the pattern and removing the pattern; finally, molten metal is poured into the mold.

In cases where a small number of castings are to be made the foundry pattern is usually of varnished wood, but in the production of a large number of castings, it may be of iron, brass, or other metal. The pattern differs in two important ways from the original: its dimensions are slightly enlarged to compensate for the shrinkage of the casting as it cools; and patterns of hollow objects have projections that correspond to the cores described below. Although

FOUNDING



Equipment and procedures for founding a section of pipe.

patterns can be made in one piece, a complicated casting is easier to remove from the mold if it consists of two or more parts. Patterns of objects with straight sides are usually made with a slight draft or taper for the same reason. Pattern parts are fitted with matching pegs and holes to insure precise alignment when assembled. The molding of a pattern and the pouring of a casting can best be understood by describing the production of a simple casting such as a pipe with a flanged end, as illustrated in Fig. 1. The pattern for this casting is shown in Fig. 2. The molds for most castings are prepared in flasks, wooden boxes without top or bottom equipped with pegs or other devices, that enable the boxes to occupy the same relative position when fitted together, shown in Fig. 3. The lower one is called the drag, and the upper one the cope. In making the mold, the flat portion of one half of the pattern is placed on a flat surface and the drag is inverted and placed around it. Molding sand is poured into the flask and rammed down until the entire flask is filled. The flask is then turned over and the other half of the pattern is set in place, as in Fig. 4. A layer of special dry sand, called parting sand, is sprinkled on the surface of the flask; then the cope is placed in position, filled with sand, and rammed. The two halves of the mold are then taken apart and the pattern is drawn or removed. One or more gates or pouring holes are then pierced through the sand of the cope as well as smaller holes called risers which carry away part of the steam formed when the hot metal is poured into the mold.

Finally, the core, the part of the mold which forms the hollow within the casting, is prepared. In the pipe shown in Fig. 1, this core

takes the form of a simple cylinder, but a complex casting may require one or more intricately-shaped cores. The cores are formed in divided core boxes which serve as patterns. After forming they are baked in an oven until they are strong enough to be handled. The core is placed within the mold (Fig. 5), and the other half of the mold is replaced. It is now ready for pouring. Having been melted in a furnace (q.v.), the metal is hand-poured from a crucible for small castings or, in most cases, from a large dipper or bucket carried by a crane or special car until the mold is completely filled to the top of the gate.

After the casting has cooled within its mold, they both are shaken out of the flasks, and the mold is broken. The rods of metal formed in the gates and risers must be sawed off or otherwise removed before further use is made of them.

The sand used in founding contains sufficient clay to make it cohesive when slightly moistened before use. Parting sand is used to make the flasks come apart cleanly when separated; this sand is dry and contains little or no clay. Sand is used for molds because it permits a certain amount of vapor and gas to escape when the casting is poured. For metals with low melting points, such as brass, it is sometimes possible to use solid molding materials such as plaster of Paris. Such molds and also metal molds (see DIE CASTING) have smoother surfaces than sand molds, producing castings with finer detail and finish than those obtainable with sand molds. They cannot, however, be used in casting iron or steel. Many variations and special techniques are involved in ordinary founding. In manufacturing, it is frequently desirable to make two or more castings in a single mold. Patterns of objects with overhanging parts may be

made with removable pattern portions so that the pattern may be drawn from the mold piece-meal without disturbing the sand. In casting such machine parts as gears, in which the rim must be as tough as possible, pieces of iron or steel called chills are sometimes placed in the mold around the rim. The chills conduct heat rapidly, permitting the portions of the casting near them to harden quickly, thus toughening the metal. Large wheels and gears are sometimes cast without flasks, in beds of sand directly on the foundry floor. In such cases, the form of the wheel rim is carved directly out of sand, and cores are placed in the mold for forming the hub and spokes.

Modern Founding Methods. A recent method for casting objects with a circular form is centrifugal casting. In such casting a circular mold is revolved rapidly during casting. No core is required because the rotation of the mold holds the metal against it by centrifugal force. This technique is particularly useful in the production of metal pipe. In investiture casting, an adaptation of the *cire perdue* (Fr., "lost-wax") process of ornamental casting, the pattern is

constructed of wax, often in a die-casting machine, and coated with a watery paste of some refractory material which is allowed to dry. This refractory shell, with the wax pattern still inside, is packed in sand, and the whole mold is baked in an oven. The wax melts and runs out, leaving the mold empty and ready to receive the metal. Castings made by the lost-wax process produce very close tolerance and reproduce fine detail accurately.

See also ELECTROTHERMIC FURNACE.

FOUNDRY. See FOUNDRY.

FOUNTAIN. See LANDSCAPE ARCHITECTURE.

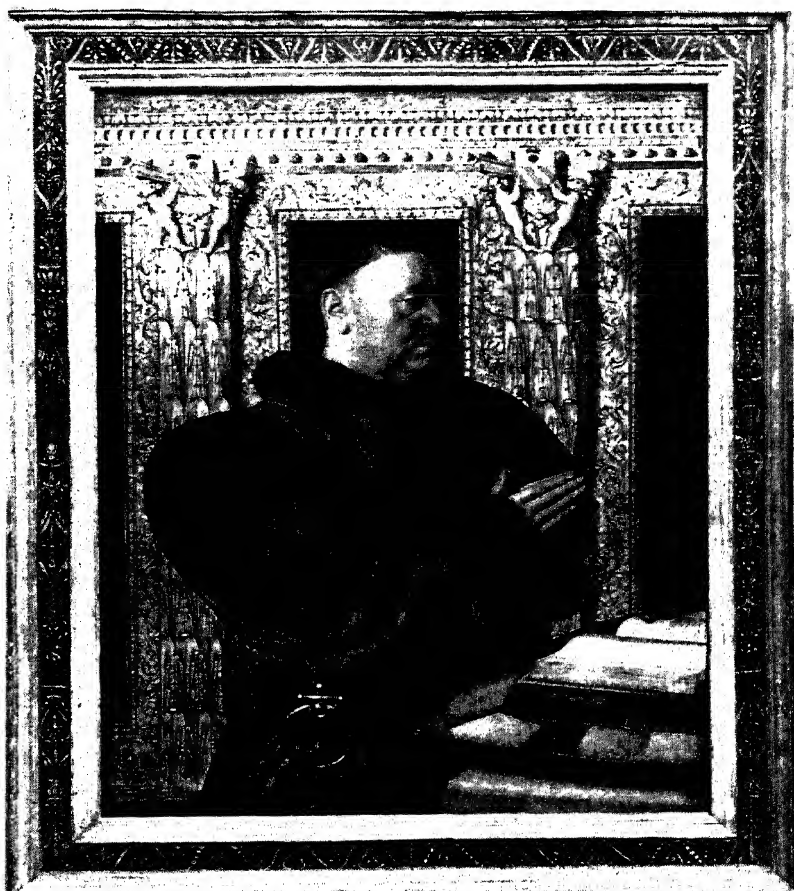
FOUNTAIN OF YOUTH. See PONCE DE LEÓN, JUAN.

FOUNTAIN PEN. See PEN.

FOUQUET, Jean or FOUCQUET, Jean (about 1416–80), French painter, born in Tours. He studied art in Tours and probably in Paris and in Italy. Fouquet was the most important French painter of the 15th century, and is considered the founder of the French school of painting. His style was based on that of the Flemish painters Hubert and Jan van Eyck (see under EYCK) and on the style used by artists of the schools of

A portrait of the French royal chancellor Guillaume Juvenal des Ursins (1401–72) by Jean Fouquet.

Archives Photographique, Paris



FOUR-EYED FISH

Florentine painting and sculpture (q.v.), especially that of the Italian religious painter Fra Angelico (q.v.); see also FRENCH ART AND ARCHITECTURE. Fouquet painted portraits and religious pictures; he also executed miniature paintings and embellishments for illuminated manuscripts (q.v.). His portraits are characterized by clear and glowing color, vigorous drawing, vivid characterization, and a sense of humor. His miniatures are noted for precise detail and exquisite workmanship. Among the few paintings definitely ascribed to him are a portrait of Charles VII (q.v.), King of France (Louvre, Paris); a portrait of a man (1456, Liechtenstein Gallery); and two wings of a religious diptych (one in the Antwerp Museum, one in the Berlin Gallery). The portrait "Man with a Glass of Wine" (Louvre) is also generally ascribed to him.

Fouquet was court painter to Charles VII and later to Louis XI (q.v.), King of France. Fouquet is especially noted for his illuminations for three *Livres d'Heures* (Books of Hours), made for members of the nobility, and containing prayers and other religious matter and also reading matter for instruction and entertainment.

FOUR-EYED FISH. See MINNOW.

FOUR FREEDOMS, designation applied to the general world aims of American policy, as defined by President Franklin Delano Roosevelt (q.v.) during World War II. In the course of an address to Congress, delivered on Jan. 6, 1941, Roosevelt said:

"In the future days, which we seek to make secure, we look forward to a world founded upon four essential human freedoms.

"The first is freedom of speech and expression—everywhere in the world.

"The second is freedom of every person to worship God in his own way—everywhere in the world.

"The third is freedom from want—which, translated into world terms, means economic understandings which will secure to every nation a healthy peace time life for its inhabitants—everywhere in the world.

"The fourth is freedom from fear—which, translated into world terms, means a worldwide reduction of armaments to such a point and in such a thorough fashion that no nation will be in a position to commit an act of physical aggression against any neighbor—anywhere in the world."

FOUR-H (4-H) CLUBS, American organization for young people between the ages of nine and nineteen years, founded in 1914 for the purpose of aiding the education of youth in farm

areas in agriculture and home economics (qq.v.) and helping them to develop good citizenship. The organization has since been broadened to include urban and suburban youngsters as well and in the late 1960's more than 25 percent of its members lived in urban areas. The organization is directed by the Extension Service of the United States Department of Agriculture (see AGRICULTURE, DEPARTMENT OF) in conjunction with State agricultural colleges and county extension organizations. Local volunteer leaders are trained and supervised by the county extension agent, who also helps interested groups organize clubs and develop programs. The name is derived from the emblem of the clubs, a four-leaf clover with an H on each leaf, representing Head, Hands, Heart, and Health. The club motto is "To Make the Best Better", and the club pledge is "I pledge my Head to clearer thinking, my Heart to greater loyalty, my Hands to larger service, and my Health to better living for my Club, my Community, and my Country".

In 1969 about 3,250,000 young people were participating in 4-H Club activities in all fifty States and Puerto Rico. Each member selects one or more projects that are considered suitable for his family situation. Projects which often pave the way to careers are offered in science, agriculture, home economics, engineering, conservation, management, personal development, community service, leadership, and citizenship. Thousands of 4-H'ers receive guidance at home through television in practical projects, such as preparedness for emergencies, home uses of electricity, automotive care and safety, and animal care. Members of 4-H clubs organize, elect officers, and plan and conduct programs, aided by adult leaders and parents.

The 4-H idea has spread to about eighty-five countries, each country adapting it to its own needs. Youngsters in foreign lands learn of 4-H through the International Farm Youth Exchange. Many come to the U.S. to live, work, and share experiences for a few months with host families.

Since its organization in 1920, the National Committee on Boys' and Girls' Club Work, Inc., has promoted the extension and expansion of the 4-H Club programs. The committee helps to promote legislation providing funds for extension work, and solicits funds for and supervises the awarding of prizes, worth \$200,000 annually, as incentives for achievements in club projects; it cooperates with the Extension Service of the Department of Agriculture in holding the annual National 4-H Club Congress, holds a 4-H Division of the National Dairy Show, and supports a 4-H program to reduce accidents on

farms. The committee publishes a monthly periodical, the *National 4-H Club News*.

FOUR HORSEMEN OF THE APOCALYPSE, in the Bible, part of the scenes of the Last Judgment depicted in the book of Revelation (q.v.). In the sixth chapter of his apocalyptic vision of God's purpose in the world, Saint John the Divine describes four horses, signifying respectively war (a red horse), civil strife (a white horse), hunger (a black horse), and death (a pale horse). The horses and their riders are frequently depicted in art and have come to be a symbol of the evils of the earthly world. *See also* APOCALYPTIC WRITINGS.

FOURIER, François Marie Charles (1772-1837), French philosopher and socialist born in Besançon, and educated at the university there. About 1799, Fourier began studying politics and economics. His first full-length work, *Théorie des Quatre Mouvements et des Destinées Générales* ("Theory of the Four Movements and of General Destinies", 1808) expounded his social system and his plans for the cooperative organization of society. The system, known as Fourierism, is based on the idea that there exists a universal principle of harmony, displayed in four departments, the material universe, organic life, animal life, and human society. This harmony can flourish only when the restraints which conventional social behavior places upon the full gratification of desire have been abolished, allowing man to live a free and complete life.

The ideal harmonious state was to be accomplished by dividing society into cooperative phalanxes; or communities, each consisting of about 1600 people who would live in the phalanstery, a vast communal building placed in the center of a highly cultivated agricultural area. Elaborate rules were laid down for the conduct of life within the individual phalanx. Assignment of work was based on talent. Private property was not to be abolished, but there was to be a thorough mixing of the rich and the poor so that the visible distinctions between them would disappear. The communal wealth of the phalanx would provide liberally for the basic subsistence of the individual members. Marriage in the accepted sense was to be abolished, and replaced by an elaborate system regulating the social behavior of those living together.

The plan attracted little attention, and Fourier continued working as a broker in Lyon. Following the publication of his *Traité de l'Association Domestique et Agricole* ("Treatise on Domestic Agriculture Association", 1822), he went to Paris where he tried unsuccessfully to

find a wealthy person willing to finance his scheme. Fourier returned to Lyon, but in 1826 he was again in Paris, working on *Le Nouveau Monde Industriel et Sociétaire* ("The New World of Industry and Partnership", 1829).

By 1832 he had managed to collect a small band of adherents to his theories. For the most part the phalanxes that he founded failed. Fourierism was introduced into the United States in 1842 by the American social theorist Albert Brisbane (1809-90), and by 1850 more than forty phalanxes were founded, few of them lasting more than a short time. Outstanding among these experiments in communal living was the phalanx at Brook Farm (q.v.). *See* COMMUNISM. **FOURIER, Baron Jean Baptiste Joseph** (1768-1830), French mathematician, born in Auxerre, and educated at the monastery of Saint-Benoît-sur-Loire. He was an instructor at the École Normale and later at the École Polytechnique in Paris, where he taught the art of fortification and mathematical analysis from 1795 to 1798. In the latter year he joined the Egyptian expedition of Napoléon Bonaparte, later Napoleon I (q.v.), Emperor of France, and was appointed governor of Lower Egypt. After returning to France Fourier became prefect of Isère Department, serving until 1815. In 1816 he was elected to the Academy of Sciences and in 1827 to the French Academy. He was created a baron by Napoleon in 1808. His fame rests chiefly on his work in mathematics and mathematical physics. In his treatise *The Analytical Theory of Heat* (1822), he employed the trigonometric series, usually called the Fourier series, by means of which discontinuous functions can be expressed as the sum of an infinite series of sines and cosines. **FOURIERISM.** *See* FOURIER, FRANÇOIS MARIE CHARLES.

FOURNIER, Henri Alain. *See* ALAIN-FOURNIER. **FOURTEEN POINTS, THE**, name given to the proposals of President Woodrow Wilson (q.v.) designed to establish the basis for a just and lasting peace following victory of the Allies in World War I. The proposals, fourteen in number, were contained in Wilson's address to a joint session of Congress on Jan. 8, 1918. The idealism expressed in them was widely acclaimed, and gave Wilson a position of moral leadership among the Allied leaders. Opposition to various points, on the part of the European Allies, however, developed at the conclusion of hostilities, and the attempt at practical application of the fourteen points exposed a multilateral system of secret agreements between the European victors. In order to secure support of his fourteenth and most important

FOURTH DIMENSION

point, which called for the creation of an "association of nations", Wilson was compelled to abandon his insistence upon the acceptance of his full program. Wilson's fourteenth point was realized in the League of Nations (q.v.), established as a result of the Versailles Peace Conference (1919); see VERSAILLES, TREATY OF.

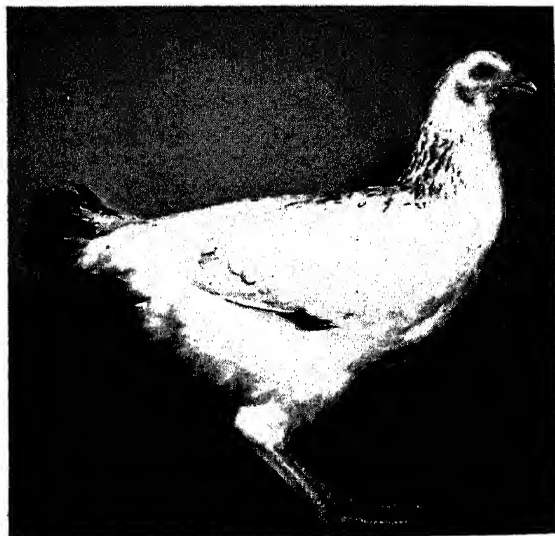
In summary, the fourteen points were: (1) abolition of secret diplomacy by open covenants, openly arrived at; (2) freedom of the seas in peace and war except as the seas may be closed in whole or part by international action for enforcement of international covenants; (3) removal of international-trade barriers wherever possible, and establishment of an equality of trade conditions among the nations consenting to the peace; (4) reduction of armaments consistent with public safety; (5) adjustment of colonial disputes consistent with the interests of both the controlling government and the colonial population; (6) evacuation of Russian territory, with the proviso of self-determination; (7) evacuation and restoration of Belgium; (8) evacuation and restoration of French territory, including Alsace-Lorraine; (9) readjustment of Italian frontiers along clearly recognizable lines of nationality; (10) autonomy for the peoples of Austria-Hungary; (11) evacuation and restoration of territory to Serbia, Montenegro, and Rumania, granting of seaports to Serbia, and readjustment and international guarantee of the national ambitions of the Balkan nations; (12) self-determination for non-Turkish peoples under Turkish control, and internationalization of the Dardanelles; (13) an independent Poland, with accessibility to the sea; and (14) creation of a general association of nations under specific covenants to give mutual guarantees of political independence and territorial integrity.

FOURTH DIMENSION. See GEOMETRY: *Four-Dimensional Geometry*; RELATIVITY.

FOURTH OF JULY. See INDEPENDENCE DAY.

FOWL, term originally meaning any kind of bird (q.v.), and later applied chiefly to edible species. Except in combinations such as water-fowl and wild fowl, in modern usage the word usually is restricted to the common domestic fowl or chicken, *Gallus gallus* or *G. domesticus*. In poultry markets, fowl commonly means a full-grown female bird. Young birds of both sexes, such as broilers and fryers, are called chickens. On poultry farms, male chickens are called roosters or cocks; females, especially those more than a year old, are called hens; females less than a year old are called pullets; very young chickens of either sex are called chicks; castrated males are called capons.

Like the turkey, pheasant, quail, and other members of the order Galliformes, *G. domesticus* is adapted for living on the ground, where it finds its natural foods, consisting chiefly of worms, insects, seeds, and green stuff. The feet, usually four-toed except in the English breed, Dorking, are designed for scratching the earth. The large, heavy body and short wings make it incapable of flying except for short distances. The crop is large and the gizzard strongly muscular. In adults of both sexes the head is decorated with wattles and with a naked, fleshy crest, called the comb, which is more prominent in the male and is variously shaped in the different breeds and varieties. The typical comb is single, serrated and relatively large, either erect or drooping. A variation is the rose comb, with three rows of tubercles merging in a rearward-pointing spike. The pea comb of the Brahma has three low serrated ridges, and the leaf comb of the French Houdan has two ridges, set transversely on the head. The strawberry comb of the Malay fowl is a small, rounded, nodular protuberance set near the eyes, and the V-shaped comb of the La Flèche fowl suggests a pair of tiny horns. Plumage of various fowl ranges in color through white, gray, yellow, blue, red, brown, and black.



Experiments in crossbreeding are carried on by the Department of Agriculture in order to improve the flavor and nutritional value of poultry. One of these superior crossbreeds is the female Beltsville Broiler.

U.S. Dept. of Agriculture

In size and shape the various breeds show great diversity. The 12-lb. Brahma cock, for example, has a miniature counterpart, a Bantam, weighing about 20 oz. The proportions of the long-legged game fowl contrast sharply with

those of the squat Cochín. The stubby tail of the latter is one extreme; another extreme is presented by the Japanese or Yokohama breed, in which the tail feathers of the cock may be as much as 6 ft. long. In general the members of one breed are alike in shape, the varieties of the breed differing in minor characteristics such as the shape of the comb, and in color and markings. A group of breeds developed in a single country or geographical area is often called a class.

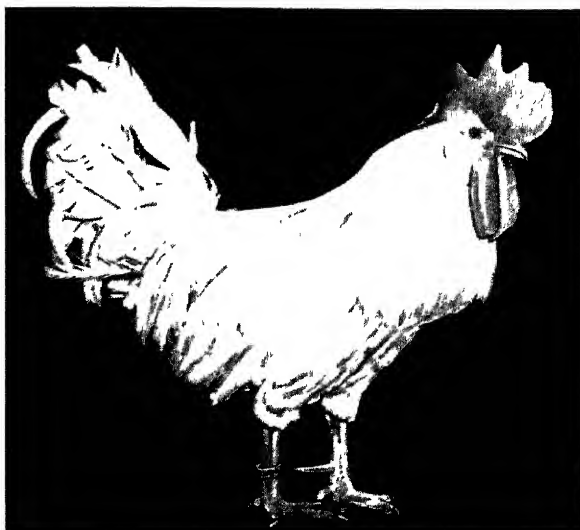
In habit, chickens are strictly diurnal and highly gregarious. The cocks are polygamous; those of the game breeds especially are noted for their courage and pugnacity in winning and defending their harems. The high fecundity of the species is an important characteristic, especially because the eggs as well as the meat are prized as food; see EGG. Unless otherwise trained, hens lay their eggs on the ground, in tall grass or weeds. Periodically, domestic hens become broody; that is, they stop laying and show a strong desire to sit on their nests and hatch chicks. The incubation period is about three weeks. The chicks, like the young of other Galliformes, are precocial; that is, when hatched they are not naked but covered with down, and are immediately able to run around. Although able to feed themselves, newly hatched chicks can survive about a week without eating, subsisting on egg yolk which is included in the abdomen. See INCUBATION.

The original home of domestic fowl was in southwestern Asia. The British naturalist Charles Robert Darwin (q.v.) considered them descendants of a single species of jungle fowl (q.v.), *G. gallus*, which is found in the wild state today in India. Some modern zoologists, however, believe that several species of jungle fowl may have contributed to the development of *G. domesticus*.

The chicken was one of the first domestic animals to be mentioned in recorded history; it is referred to in ancient Chinese documents which indicate that this "creature of the west" was introduced into China about 1400 B.C. Fowl are depicted in Babylonian carvings of about 600 B.C., and are mentioned by early Greek writers, notably by the playwright Aristophanes in about 400 B.C. The Romans considered chickens sacred to Mars, their god of war. From ancient times the rooster has been a symbol of courage; it was so regarded by the Gauls, for example. In Christian religious art the crowing cock has been used to symbolize the resurrection of Christ. The cock was the emblem of the first French republic.

Today domestic fowl, which form by far the most important class of poultry, are distributed virtually all over the world. In the United States the current trend is toward specialized poultry farming; some poultrymen producing hatching eggs, others eggs for table use, and others raising chickens to market as broilers; see POULTRY.

Types of Fowl. Numerous breeds and several hundred varieties of fowl are now recognized; new varieties are in the making, moreover, as breeders strive to improve their stock for partic-



White Leghorn rooster.

ular purposes. The breeds may be classified according to the parts of the world in which they originated, and also according to their function. One category is the game fowl still bred in some areas for their fighting qualities; see COCKFIGHTING. Elsewhere, game breeds are kept by fanciers for ornamental purposes and for exhibition at poultry shows. The exhibition varieties of game fowl are characterized by long necks and shanks and sparse tail feathers. Other ornamental breeds are the bantams, and such types as the Japanese fowl, the Polish fowl with its great crest of feathers, the downy-feathered Silky, and the ragged-looking Frizzle.

Among breeds of economic importance the oldest class, originating in China in the remote past, is the Asiatic group, including the Brahmans, Cochins, and Langshans. They are large, heavy birds with thick, fluffy plumage and feathered shanks. Their meat is coarse in texture, and they are poor egg producers. They are hardy, however, and thrive in cold climates. Asiatic stock has contributed greatly to the formation of the American breeds.

FOWL CHOLERA

English fowl are distinguished for the fine quality of their meat, and, like the French breeds, are more valuable as table birds than as egg layers. The Belgian Campines, on the other hand, are small but prolific. The outstanding egg producers are the Mediterranean breeds, which include the Anconas, Andalusians, Minorcas, and Leghorns, the single-comb White Leghorn being the most popular variety. Except for the Minorcas, the Mediterranean fowl are small and therefore uneconomical as meat poultry, but they consume relatively little feed. They are generally prolific, and their white eggs are large in proportion to their body size. The cost of egg production is lower, therefore, and the profits often higher, than with other types of chickens. The pullets begin to lay early, and have the advantage, from the commercial point of view, of poorly developed maternal qualities; little laying time is lost in broodiness. These birds are sensitive to environmental changes. They are healthiest and lay most eggs in mild climates; in cold weather they may suffer, especially from frostbite in their large combs and wattles. They are nervous and agile, and can fly over low fences.

The American class consists of general-purpose breeds developed in the past century to serve as producers of both meat and eggs. American breeds are moderate or large in size, with meat of good quality. They are very hardy, and lay well in winter. Rhode Island Reds are often as prolific as single-comb White Leghorns. The maternal instinct is strong in American fowl, but in some strains has been minimized by selective breeding. Usually birds of this class mature later than Mediterranean fowl but earlier than Asiatic fowl. An exception in this respect is the fast-growing New Hampshire breed, formerly much used for broilers and fryers. This breed has been crossed with Cornish and white Plymouth Rock breeds to evolve faster-growing and more efficient meat producers. These new types often bear the names of the breeder-originators, and account for the millions of broilers, fryers, and roasters now produced. Other American breeds are the Wyandotte and Plymouth Rock, each with several varieties, and the Dominique, Java, and Buckeye.

See separate articles on the individual breeds mentioned above. See also DUCK; FOWL CHOLERA; GOOSE; GUINEA FOWL; INCUBATOR; TURKEY; VETERINARY MEDICINE. R.R.St.

FOWL CHOLERA or **CHICKEN CHOLERA**, infectious fowl disease which affects the intestinal tract, causing severe inflammation and functional disorders. Chickens are particularly susceptible to this disease, and the mortality rate is

high. The causative organism is *Pasteurella multocida*, a bacterium that gains entrance to the bird through the mucous membranes, the respiratory tract, or the digestive tract. The organisms are present in the excrement of infected fowl, but die when exposed to heat or sunlight. The disease may be acute and run a short course, or it may be chronic and extend over a long period of time. Some fowl harbor the microorganisms for years without manifesting any symptoms, thus acting as carriers of the disease. Since no cure has been found, treatment consists of isolating infected fowl and removing all infected refuse. A blood agglutination test has been developed which makes possible the detection of the microorganisms even in carrier fowl, but this test is still in the experimental stage and is not widely used. The typical symptoms of the disease are lethargy, elevated temperature, purple coloration of the comb, and sometimes diarrhea. In the United States fowl cholera is most prevalent in the Midwest, but may occur in any locality. It is a serious problem for anyone raising, transporting, or marketing fowl. See ANIMALS, DISEASES OF.

FOX, common name for a carnivore of the dog family (Canidae), resembling a small, short-legged wolf. The elongated, narrow, pointed muzzle and long, bushy tail are the most distinctive external features of the fox, which is also usually characterized by erect triangular ears and by thick fur with long guard hairs. The eyes resemble those of a cat, the pupils being elliptical when contracted. The term fox is sometimes restricted to the males, the females being called vixens. Originally all foxes were classified in the genus *Canis*, which includes domesticated dogs and the wolf, coyote, and jackal. In more recent classifications, however, the various species of foxes are assigned to several genera of their own, mostly to *Vulpes*. The members of *Vulpes* differ from species of *Canis* in cranial structure. In *Vulpes*, for example, the nasal passages do not open into the frontal sinuses.

The Red Foxes. Typical of the genus *Vulpes* is *V. vulpes*, the common or red fox of the Old World. It is distinguished by black ears and feet and by a white tip on the tail. Usually the coat is some shade of rusty red or reddish brown, sprinkled with light-tipped hairs, and fading to a pale hue or white on the belly. The red fox of North America is so closely similar that some zoologists include it in the same species, although others classify it separately as *V. fulva*.

Together *V. vulpes* and *V. fulva* have a natural range covering virtually all of the Northern

North American red
fox, *Vulpes fulva*

Charles J. Ott —
National Audubon Society



Hemisphere. The common fox is found throughout most of Europe, in all of Asia lying in the temperate zone, and in Africa north and south of the Sahara. In North America where the red fox has been steadily spreading southward into new territory, its range extends from the Arctic as far south as Mexico. Australia has no native foxes, but the Australians, as part of their efforts to control the plague of rabbits, imported the common fox from Europe, and this country now supplies a major portion of the red-fox skins to the fur markets of the world.

In their vast range the red foxes have developed numerous local subspecies which show great diversity in external characteristics. *Vulpes fulva* generally grows to a length of about 3½ ft., including about 14 in. of tail, but among the various red foxes in different parts of the world the size varies considerably, southern races being usually relatively small. Those adapted to cold climates have comparatively heavy fur, and provide the most desirable pelts. Examples of color variation are the black-bellied fox of southern Europe, and a Himalayan subspecies which in its full winter pelage is marked with a dark stripe across the shoulders. In general, the subspecies inhabiting arid regions are paler in hue.

Color variation occurs not only among different varieties or subspecies which are natives of different regions, but also locally among different phases of common parentage. In a single litter the cubs may range from bright brick-red to black. Black foxes, like red foxes, have white-

tipped tails. Except in the Hudson Bay region of Canada black foxes are extremely rare, but some degree of melanism in red foxes is not unusual.

The cross fox and silver fox, the pelts of which bring premium prices, are not distinct species but merely variant red foxes occurring in far-northern latitudes. A cross fox resembles other members of *V. vulpes* and *V. fulva* except for a more or less distinct dark cross formed on the back by a dorsal stripe and a band across the shoulders. The silver fox has black fur with a frosted appearance due to numerous guard hairs tipped with silver gray or white. In this phase the soles of the feet are furred. Silver foxes are rarer in the wild state than are cross foxes or even black foxes, but in recent years they have been bred successfully on fur farms.

Other Species. In addition to the common fox, several other species appear in different parts of Asia. *V. bengalensis* of northern India, for example, is an alert little animal with a grayish coat and a black-tipped tail. The Tibetan sand fox, *V. ferrilata*, is distinguished by a narrow head, small ears, a short tail, and a yellowish coat, and is exceptional in having round pupils. The corsac, *V. corsac*, of central Asia is also sometimes referred to as Afghan fox. Africa has the smallest of all foxes *Fennecus zerda*, the fennec (q.v.). Another African species is a gray fox, *Otocyon megalotis*, which has long legs, enormous ears, and tiny teeth. It is extraordinary among higher mammals in having fourteen, or sometimes sixteen, molar teeth.

In North America the kit fox, *V. velox*, also called the swift fox for its speed in running, ranges from southern Canada to northern Mexico in prairie and desert areas. It is small, reaching a length of about 30 in., including the tail.

It is marked with a dark patch on either side of the nose, and has a coat of warm buff in summer and gray in winter. Like the arctic fox, the kit fox has hairy soles. Another species is the long-eared kit fox, *V. macrotis*, found along the coast of southern California and Lower California. It is characterized by very large ears and a slender build. Its fur is gray on the head, back, and tail, with a warm buff color on the sides.

At one time the American gray fox, *Urocyon cinereoargenteus*, ranged over virtually all of North America as far north as New England. This species prospers mostly in wooded country, however, and with the spread of agriculture it was pushed out of some of the northern parts of its range, although it is still fairly common in some localities. The gray fox is found in considerable numbers today in the South and West, but is still losing ground to the more adaptable red fox, which flourishes in open country as well as in woodland. The gray fox is a little smaller than the red fox but otherwise resembles it in body form. The fur, pepper and salt gray with buffy underfur and rusty yellow on sides of neck, backs of ears, legs, and feet, is of relatively poor quality. A peculiarity of this species is a crest of concealed, stiff hairs on the tail.

The barren lands and ice fields circling the North Pole and the open coastal plains in Alaska north of the timber line are inhabited by the white or arctic fox, *Alopex lagopus*. It has furred soles. Its coat in summer is smoky brown on the upper parts, but in winter turns completely white. The valuable blue fox of southeastern Alaska, the Aleutian Islands, and western Greenland (where they make up 50 percent of the fox population) is a phase of the arctic fox. In all members of the species the underfur has a bluish tint, and often this blue-gray tone is seen in patches in the summer pelage. In the blue fox the slaty color is dominant and persists throughout the year. Blue foxes have been bred commercially on some of the Aleutians; see FUR.

Characteristics and Habits. Although bred on fur farms, foxes cannot be considered domesticated. In the wild state they are solitary hunters, never being seen in packs as are dogs and wolves. Their prey consists largely of small mammals such as rabbits and mice, and of birds which roost or nest close to the ground. Frogs, shellfish, insects, and also fruit and some roots may be included in the diet.

Ordinarily the fox is nocturnal, retiring during the day to a den. The den may be a burrow dug in the earth, or may be a hole among rocks or the hollow of a stump or fallen log. The American gray fox, which is able to climb trees, often uses a hollow log. Foxes do not hibernate; even in the Arctic Regions they are active throughout the winter. Their hardiness is shown also in their ability as mountain climbers.

Intelligence in foxes is an outstanding characteristic. Their cleverness in avoiding traps and poisoned bait equals their celebrated ingenuity in eluding hounds on the trail. Man is their chief enemy. Although in Great Britain fox hunting (q.v.) provides a motive for protective measures, in most other parts of their range these animals are constantly menaced. They are trapped and hunted not only for their fur but also to protect poultry from their occasional depredations. Under such conditions they continue to flourish, however, even in areas which have large human populations.

In popular belief the family life of foxes has been somewhat romanticized. Where the animals are rare, undoubtedly the same fox and vixen have been observed together in the mating season in several succeeding years. Lifetime monogamy, however, has never been proven either for foxes in general or for any particular species. A pair of foxes often if not always remain together while the cubs are young, the fox as well as the vixen bringing food to the den. Among the red foxes a litter of four or more cubs is born in the spring, after a gestation period of about forty-nine to fifty-six days. Like kittens, the cubs are blind for the first ten days. By autumn they are able to care for themselves, and when one year old are considered fully grown. Their life span is about twelve years.

I.T.S.

FOX, North American Indian tribe of Algonquian-language stock, formerly living in Wisconsin. They were called Fox (*Renards*) by the French, possibly because they had a Fox clan, but they referred to themselves as Muskewakium or "the red-earth people". The Fox, an agricultural people with an eastern-woodlands type of culture, were driven from the Lake Superior region by the Ojibwa (q.v.). Subsequently they were engaged in a disastrous war with the French, as a result of which they united with the Sauk in 1760. The Sauk, or Sac, also an Algonquian tribe, originally inhabited Michigan, but later migrated to Wisconsin, finally settling on both banks of the Mississippi R. in Illinois and neighboring areas. In 1832 the two tribes resisted the execution of a treaty with the United

States by which they had agreed to cede their lands east of the Mississippi (see **BLACK HAWK**). The Fox and Sauk, numbering about 450, now live on reservations in Iowa, Kansas, and Oklahoma.

FOX, name of a family of British peers, statesmen, and soldiers.

Henry Fox, 1st Baron Holland (1705–74), son of Sir Stephen Fox (1627–1716), born in London, England, and educated at Christ Church, University of Oxford. Upon entering Parliament in 1735 he became a Whig supporter of Sir Robert Walpole, 1st Earl of Orford (see *under* **WALPOLE**), and from 1737 to 1742 he was surveyor general of works. In 1743 Fox was lord of the treasury, and from 1746 to 1754 secretary at war and a member of the privy council. Although leader of the House of Commons and secretary of state in the cabinet of Thomas Pelham Holles, 1st Duke of Newcastle (see *under* **NEWCASTLE**), in 1755, Fox was excluded from the government in the cabinet reorganization of 1757, and was instead made paymaster general of the armed forces. As a paymaster general during the Seven Years' War (q.v.), he acquired a large fortune, and in 1762 was given a seat in the cabinet of John Stewart, 3rd Earl of Bute (1713–92). Again leader of the House of Commons, Fox secured approval of the Treaty of Paris (1763) by means of persuasion, bribery, and intimidation, and was raised to the peerage in reward. He was forced to resign as paymaster general in 1765, and four years later charges of misuse of public funds were brought against him. The proceedings in the court of exchequer, however, were stayed by the intervention of George III (q.v.), King of Great Britain.

Charles James Fox (1749–1806), statesman and orator, third son of the 1st Baron Holland, born in Westminster, England, and educated at Hertford College, University of Oxford. When he was nineteen years old, his father purchased for him the pocket borough of Midhurst, and in 1768 Fox won a seat in Parliament as a Tory. A supporter of the Crown, he was appointed junior lord of the admiralty in the ministry of Frederick North, 2nd Earl of Guilford (q.v.), in 1770, but he resigned in 1772 in order to oppose the Royal Marriage Act, a favorite project of George III. Late in 1772 Fox was appointed junior lord of the treasury, but his independent thinking and his openly expressed sympathy for the American colonists aroused the anger of the king, who secured his dismissal early in 1774. He joined the Whig opposition party partly through the influence of his friend the British orator and statesman Edmund Burke (q.v.). Fox's brilliant oratory



Charles James Fox

led the forces opposing the coercive policies of the government toward the American colonies.

On the fall of the North ministry in 1782 Fox became secretary of state for foreign affairs in the cabinet of Charles Watson-Wentworth, 2nd Marquis of Rockingham (q.v.), over the king's opposition. He obtained a grant of complete legislative independence for Ireland but found himself in sharp disagreement with William Petty, 2nd Earl of Shelburne (see *under* **LANS-DOWNE**), the home secretary, particularly over the peace negotiations with the American colonies. When the king offered Shelburne the premiership on Rockingham's death, Fox resigned. Claiming that the cause of their quarrel was over, Fox and North formed a coalition that defeated the Shelburne ministry and placed Fox and North in the cabinet of William Henry Cavendish Bentinck, 3rd Duke of Portland (1738–1809) in 1783 as secretaries of state. The ministry fell at the end of the year following the introduction by Fox of an India bill, vesting the government of India in a commission appointed by Parliament; the bill was defeated by the personal opposition of the king.

From the fall of the Portland government until 1806 Fox was kept out of office. His ardent support of the French Revolution (q.v.), in which he was almost alone in Parliament, placed him in opposition to the foreign policy of the prime minister William Pitt, the Younger (see *under* **PITT, WILLIAM**), and cost him Burke's friendship.

FOX, GEORGE

In 1797 Fox withdrew from Parliament. The following year at a Whig dinner he made a toast to "Our Sovereign, the people", for which he was removed from the Privy Council. In 1800 he returned to Parliament to participate in the vote to censure the ministers for refusing the peace overtures of Napoléon Bonaparte, later Napoleon I (q.v.), Emperor of France. In 1804 George III excluded Fox from the proposed coalition ministry of William Wyndham Grenville, Baron Grenville (q.v.). The death of Pitt in 1806, however, left Fox the outstanding British statesman; the king therefore did not oppose Fox's post of foreign secretary in the Grenville ("All-the-Talents") ministry.

Fox's reputation as one of the outstanding British statesmen is based not upon his ability as an administrator, for he passed most of his career in the opposition, but upon his brilliant oratory and astute political criticisms. He was far in advance of his time on many issues, such as his evaluation of the French Revolution. His opposition speeches are noted for their clarity of thought and sharpness of language.

Henry Richard Vassall Fox, 3rd Baron Holland (1773–1840), grandson of the 1st Baron Holland and nephew of Charles James Fox, born in Winterslow House, Wiltshire, and educated at the University of Oxford. Like his uncle he consistently supported the Whigs in the House of Lords. He was admitted to the privy council in 1806, and was Lord Privy Seal in 1806 and 1807. After the fall of the Whigs in 1807 he was in the opposition until 1830 and fought for all Whig measures, especially for the reduction of the severity of the penal codes. He introduced a bill for the abolition of the death penalty for stealing in 1809. He favored repeal of the corn laws (q.v.), and opposed the orders in council which led to the War of 1812 (q.v.). In 1830 he became chancellor of the Duchy of Lancaster. Despite his political activities he is best known as a patron of literature and as a writer. His wife, Elizabeth Vassall (1770–1845), presided over a salon at Holland House which became famous in British history for brilliant political, literary, and social gatherings. His works include biographies of the Spanish dramatists Guillén de Castro y Bellvis and Lope de Vega (qq.v.) and his uncle. His memoirs, among them *Foreign Reminiscences* (1850) are valuable sources for the political life of his time.

FOX, George (1624–91), English religious leader, founder of the Society of Friends (see FRIENDS, SOCIETY OF), or Quakers, born in Fenny Drayton, Leicestershire, to a Puritan (see PURITANS) family. When Fox was nineteen, he be-

lieved that he was beginning to receive mystical revelations in which the voice of God told him to be directed by Christ alone. He described these revelations, which he took as a sign that everyone should be guided by his individual "inner light", as coming to him while he waited in an absolutely calm frame of mind and as being preceded by violent physical agitation, or "quaking".

In 1647 Fox began to preach his "inner light" doctrine, speaking against formalized religion, particularly Presbyterianism (q.v.), and advocating divine communion as he practiced it. He objected to political and religious authority, opposed war and slavery, and believed that all human actions should be directed by inner contemplation and a social conscience inspired by God. Fox attracted many converts, especially from the lower middle class. Both the civil and religious authorities were perturbed, however, and began to persecute the preacher and his followers.

In 1649 Fox was imprisoned at Nottingham for interrupting and rebuking a minister who was expounding the authority of the Scriptures. A year later, he was jailed at Derby on a trumped-up charge of blasphemy. When he was sentenced in 1650 by Justice Gervase Bennet, the preacher warned the judge to "tremble at the word of the Lord"; Bennet contemptuously called Fox and his followers "quakers", and this circumstance, together with their agitated movements during times of revelation, caused them to be known by that name.

Fox was jailed again in 1653, in 1656, and from 1664 to 1666. His movement, however, despite continued persecution, grew in size and strength, notably in northwestern England. In 1666, though weakened by hardship and the effects of imprisonment, Fox began to devote most of his time to the organization of the Quakers as a church. He was greatly assisted by Margaret Fell (1614–1702), whom he married in 1669, the year of the first great Quaker meeting. Fox embarked on a missionary journey to North America and the West Indies in 1671; on his return to England in 1673 he was again imprisoned, this time for two years. In 1677 and 1684, despite poor health, he traveled to Germany and Holland, preaching his doctrines wherever possible. By now the Quakers were firmly rooted, and Fox spent his last years, in England, helping to establish Quaker schools and communities and lobbying for passage of the Act of Toleration. This act, which granted freedom of worship to all except Roman Catholics and Unitarians, finally was passed in 1689. Among Fox's

writings, all published posthumously, are the *Journal* (1694), *A Collection of . . . Epistles* (1698), and *Gospel Truth* (1706).

FOX, John William, Jr. (1863–1919), American writer, born near Paris, Ky., and educated at Transylvania University (now Transylvania College) and Harvard University. Although Fox was both a journalist and a foreign correspondent, it was his experience as a mine operator and police officer in the Cumberland Mts. of Kentucky and Virginia that provided the background for his most popular fiction. Among his novels are *The Little Shepherd of Kingdom Come* (1903) and *The Trail of the Lonesome Pine* (1908), sentimental but accurate pictures of mountain life which were equally successful when dramatized for the theater and motion pictures.

FOXE, John (1516–87), English martyrologist, born in Boston, Lincolnshire, and educated at the University of Oxford. He was a fellow of Magdalen College, Oxford, from 1539 to 1545 and tutor to the children of the English poet and soldier Henry Howard (q.v.) from 1548 to 1553. With the accession to the throne of the Catholic Mary I (q.v.), Queen of England, he left the country, remaining on the Continent until 1559 when Elizabeth I (q.v.) became Queen of England. He was ordained a priest in 1560, and was prebendary in Salisbury Cathedral in 1563.

While in exile he had begun to work on a Latin history of Christian persecutions, *Rerum in Ecclesia Gestarum . . . Commentarii*. He completed this work in 1559, having included in it much material from the Catholic persecutions of the Protestants in England. An English translation, *Actes and Monuments of these Latter and Perilous Dayes . . .*, was published in 1563 and became popularly known as *The Book of Martyrs*. This work was the source of the popular conception of Roman Catholics for generations of English people. Its accuracy was attacked, and a second edition, corrected by Foxe, was published under the title *Ecclesiastical History, Contayning The Actes and Monuments of Things Passed in Every Kynges Tyme*. In 1570 the Anglican Convocation ordered this edition to be placed in every collegiate church in England. The work is uncritical and indicates that, at best, Foxe believed every atrocity story he heard. On the other hand, Foxe was far in advance of his time in advocating religious tolerance.

FOXGLOVE. See DIGITALIS.

FOXHOUND, large type of hound or hunting dog, used chiefly in the sport of fox hunting (q.v.). Two principal types of foxhound exist, the English and the American. The modern English foxhound has been bred in England since

the end of the 17th century. It traces its ancestry, however, to the bloodhound (q.v.) and other types of hound known for about 2000 years. The English foxhound has been bred in America since about 1880, although it is possible that the dog was imported and bred even earlier. More than 250 packs of English foxhounds exist in Great Britain. In the United States, of about one hundred packs of hounds used in fox hunting, only about ten consist of pure-bred English foxhounds.

The English foxhound has three principal characteristics: keen scent, speed, and endurance. It has a large head with a long nose and low-set ears. A strong dog, the foxhound has long and muscular shoulders and a deep chest, about 26 to 31 in. in girth. The back and loins are muscular and the legs are straight and strong. The dog has a short, dense, glossy coat which is usually tan, black, white, or a combination of the three colors. The English foxhound measures about 24 in. in height at the shoulders, and weighs about 70 to 80 lb. The female usually weighs about 10 lb. less.

Several strains of American foxhound reputedly can trace their ancestry back to a pack of hounds imported from England in 1650; other strains, to hounds imported later from England, France, and Ireland. In general the American foxhound resembles the English foxhound and the two breeds differ chiefly in size and weight.

Foxhound

UPI



FOX HUNTING

The male American foxhound ranges from about 22 to 25 in. in height at the shoulders, and the female from about 21 to 24 in. at the back; the male weighs about 60 lb. The chest of the American type is narrower in proportion to depth than that of the English foxhound, being about 28 in. in girth for a dog 23 in. high.

FOX HUNTING, pursuit of a fox, for the sake of sport, by men and women on horseback following hounds. The fox, as a prey in the sport of hunting, was mentioned in accounts from the time of Edward II (q.v.), King of England, but it was then considered inferior to the stag. It was not until the decline of falconry (q.v.) in the 17th century that the first fox hunts, consisting of organized groups of hunters and their servants and hounds, were established in England. The principal English hunts, such as the Quorn, Belvoir, Cottesmore, and Pytchley, date from the early 17th century.

In present-day practice the officials of the hunt and the members generally wear coats of bright scarlet called pinks, although different colors are worn in some districts. Members of the Troutbeck Hunt, for example, wear gray. Theoretically the hunt, costing about £2000 or more a year, is supported by the annual subscriptions of the members, but in fact it is usually maintained by the Master of Fox Hounds (M.F.H.) from his personal resources.

In earlier days, hunting the drag, or trail left by the fox, was common. The foxhounds (see **FOXHOUND**) were set to find the scent left by a fox and to pursue it across country along that trail. In areas where woodland is scanty, the method of drawing a covert is preferred. In this method, a pack of twenty-five to forty hounds is set by the huntsman to seek through a covert or wood in which the fox has its earth, or den.

When a fox is found and starts to run, the whole hunt follows it in full cry across the countryside. Any damage that is done to property is paid for by the hunt or the M.F.H. Those who are present when the hounds catch the fox are said to be in at the death. If a kill is made, the first riders are presented by the master with the tail, or brush, the head, or mask, and the feet, or pads. The remainder of the animal is immediately cut up and fed to the hounds.

In Great Britain the sport has become entangled in a network of social conventions, even to the extent of the enactment of laws permitting a hunt to trespass freely over private property.

Although fox hunting began about the same time in America as in Great Britain, the development of the sport in the United States has been hindered by certain conditions. The American

farmer generally exterminates foxes to protect his poultry, whereas in Great Britain foxes are jealously preserved. In America a kill is the exception in the average hunt. Earths are never filled in or stopped, as in British fox-hunting country, and attempts to dig out a fox that has taken refuge in an earth are rarely made.

Unverifiable references to fox hunting exist from the time before the governor of Virginia established a pack on his estate in 1742. This hunt is the earliest of which details are known. Other hunts were later established, including those in Philadelphia, Pa., and Brooklyn, N.Y., and the hunt at Hempstead, Long Island, to which the American President George Washington (q.v.) was a subscriber. The American Revolution, however, put an end to those early hunts. The oldest established hunt on the North American continent with a continuous history is the Montréal Hunt in Canada, dating from 1826. Considerable popular opposition to the pastime exists among members of humane societies and their sympathizers.

FOX TERRIER, breed of terrier (q.v.), once used for driving a fox out of its hiding place when pursued by hounds, but now used chiefly as a pet. Two types of fox terrier exist, the smooth and the wirehaired. Both types early originated in England, stemming probably from different ancestors. The two types were interbred in order to give the wirehaired type the white color and more sharply defined head of the smooth type. In recent years, however, the two types have been kept separate so each may preserve its distinctive coat. Both types have

Wirehaired fox terrier

UPI



similar characteristics, excepting the texture of the coat, which is smooth, flat, dense, and hard in the smooth fox terrier, and hard and wiry in the wirehaired type. The predominant color of the coat of each is white, with markings of black or tan. The fox terrier has a fairly long, lean head, with a flat skull, a long muzzle, small, V-shaped ears, and small dark eyes. The chest is deep but not broad and the back is short and straight. The loins are muscular and the tail is carried high. The male is about 15½ in. high at the shoulders and weighs about 18 lb.; the female is of slightly smaller stature and weighs about 16 lb. The fox terrier is one of the most widely distributed and popular dogs.

FOX-TROT. See *DANCE: Popular Dance in Western Civilization: Ballroom and Social Dance.*

FRA ANGELICO. See *ANGELICO, FRA.*

FRACTION, in mathematics, subdivision of any unit that is divided into a number of equal parts. A linear foot is divided into inches, so an inch is a fraction of one foot. In modern mathematics the fractions are technically known as the set of rational numbers (q.v.), the class of numbers that can be expressed as the quotient of two integers (whole numbers). The existence of this set is formally demonstrated by constructing it as an algebraic extension of the set of integers. The set of rationals differs from the set of integers in that the former is an algebraic field and the latter is an integral domain (see *ALGEBRA*).

The usual notation for a fractional quantity consists of two numbers separated by a horizontal line. The number of equal parts into which the whole unit has been divided is placed below the line; the number of these parts that the fraction contains is placed above the line. The number below the line is called the denominator, which is never zero because division by zero is impossible, and the number above is called the numerator of the fraction. Thus, 7 in. is expressed as a fraction of 1 ft. by $\frac{7}{12}$. Quantities expressed in this way are called

vulgar, or common, fractions; they are proper fractions when the numerator is less than the denominator, and improper when the numerator is greater than the denominator.

Decimal Fractions. When the denominator is 10 or a power of 10, the quantity is called a decimal fraction. The denominator of a decimal fraction may be indicated by the position of a decimal point rather than written. Thus the fraction $\frac{1}{10}$ may be represented by 0.1, $\frac{1}{100}$ by 0.01,

$\frac{1}{1000}$ by 0.001, and so on. The decimal fraction 4.3679 is thus equivalent to $4 + \frac{3}{10} + \frac{6}{100} + \frac{7}{1000} + \frac{9}{10,000}$.

Not every fraction can be represented in its entirety in finite decimal form. Reduction of $\frac{1}{3}$ to a decimal fraction results in 0.33333 . . . , the 3 continually recurring to an unlimited number of decimal places. Similarly, $\frac{4}{27}$ reduced to a decimal fraction becomes 0.148148148 . . . , the group 148 being repeated in an indefinitely long series, each successive repetition being $\frac{1}{1000}$ as great as the preceding; that is, $\frac{4}{27}$ equals $\frac{148}{1000} + \frac{148}{1,000,000} + \frac{148}{1,000,000,000}$ and so on. Decimal fractions of this kind are called repeating decimals. See *DECIMAL SYSTEM*.

Continued Fractions. A fraction in which the numerator is an integer, and the denominator is an integer plus a fraction, the denominator of the latter fraction also being an integer plus a fraction, and so on, is called a continued fraction, such as

$$x_1 + \frac{y_2}{x_2 + \frac{y_3}{x_3 + \frac{y_4}{x_4 + y_5}}}$$

Such a fraction may terminate eventually or may continue indefinitely. Any rational number may be expressed as a terminating continued fraction, with all numerators equal to one. The rational number $\frac{840}{611}$, for instance, can be developed as

$$\frac{840}{611} = 1 + \frac{1}{2 + \frac{1}{1 + \frac{1}{2 + \frac{1}{76}}}}$$

Irrational numbers may be expressed as continued fractions. $\sqrt{2}$, for instance, can be developed as

$$\sqrt{2} = 1 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \dots}}}}$$

FRACTIONAL DISTILLATION

e , the base of natural logarithms, can be developed as

$$e = 2 + \frac{1}{1 + \frac{1}{2 + \frac{2}{3 + \frac{3}{4 + \frac{4}{5 + \dots}}}}}$$

A third irrational number, π , can be expressed as

$$\pi = \frac{4}{1 + \frac{1^2}{2 + \frac{3^2}{2 + \frac{5^2}{2 + \frac{7^2}{2 + \frac{9^2}{2 + \dots}}}}}}$$

J.Si.

FRACTIONAL DISTILLATION. See DISTILLATION; PETROLEUM: *Refining*.

FRACTURE, in anatomy, break or crack in a bone or in ossified cartilage; see BONE. Simple, or closed, fractures are not visible on the surface. Compound, or open, fractures involve a rupturing of the skin, often exposing the bone. Single and multiple fractures refer to the number of breaks in the same bone. Fractures are complete if there is a total break, or incomplete (greenstick) if the fracture occurs only part of the distance across a bone shaft, accompanied by a bending or crushing of a bone that is not completely broken through. Incomplete fractures are found most commonly in young children, whose bones are more resilient. A comminuted fracture is one in which the bone has been fragmented at the fracture site; an impacted fracture is one in which parts of the adjacent surfaces of the break are driven together. Any fracture may be transverse, oblique, spiral, or longitudinal, according to the direction it takes in relation to the shaft of the bone. See FIRST AID: *Sprains and Fractures*.

The usual symptoms accompanying a fracture are severe local pain and tenderness, swelling, and, if the ends are not impacted, grating when the broken ends are moved across one another. Varying degrees of deformity may also be present. X-ray examination is the only adequate method of detecting a fracture and is essential to determine the type accurately.

Infection associated with compound fractures is treated by antiseptics and antibiotics; see INFECTION. Proper alignment of the broken segments is obtained by various means. If the segments lie adjacent to each other, stretching or

traction to overcome the pull of powerful muscles may be required to achieve realignment, although external manipulation may sometimes be sufficient to bring the segments together. This is called closed reduction. If proper alignment cannot be achieved in this fashion, an operation is usually performed, and the fragments are joined with screws, nuts, nails, wires, or metal plates. This is an open reduction. Once alignment is achieved, the relative positions of the segments are externally secured by means of casts or splints, usually made of plaster, that immobilize the fracture site to facilitate healing. Fractured ribs need not be so secured, but the chest is often strapped or taped to reduce motion with breathing and thus alleviate pain. In healing, the body creates new tissue to join the broken segments across the line of the fracture. Minerals in this tissue harden and gradually form new bone to recreate a solid structure. Fluids within the tissues that cause swelling are gradually reabsorbed. Healing is most rapid in children. In relatively healthy persons, properly treated fractures usually heal without complications. The union of bone fragments is often delayed in persons with chronic ailments and deficiency diseases. Fractures of joints are more difficult to treat because normally smooth opposing surfaces may be destroyed and require restoration by bone grafting.

Although most fractures are caused by heavy impact, relatively simple activity such as throwing a baseball may cause a break, as in the upper arm. Children who suffer from osteogenesis imperfecta, a failure to complete the process of bone structure, may experience repeated fractures from the slightest shock; the condition usually disappears with the onset of puberty.

FRACTURE, in engineering, the breaking of a metal or a metal part as a result of repeated application of stress or temperature differences, which result in creep and fatigue (qq.v.). See also METALLOGRAPHY; METALS: *Physical Properties*; TENSILE STRENGTH.

FRAGMENTAL ROCKS. See SEDIMENTARY ROCKS.

FRAGONARD, Jean-Honoré (1732–1806), French painter, born in Grasse. He began to study painting at the age of eighteen in Paris with Jean Baptiste Siméon Chardin (q.v.), but formed his style principally on the work of his next master, François Boucher (q.v.). Fragonard won the Prix de Rome in 1752. After studying for three years with the French painter Carle Van Loo (1705–65), he studied and painted for six years in Italy, where he was influenced by the paintings of the Venetian master Giovanni Bat-

"The Pursuit", oil on canvas by Jean-Honoré Fragonard, one of a series of four large paintings called "The Progress of Love" that he was commissioned to do by Madame du Barry for the dining pavilion of her château at Louveciennes. Painted approximately between 1771 and 1773, the pictures were rejected by Madame du Barry, possibly because they were too rococo for the neoclassical setting in which she wanted to hang them.
Frick Museum



tista Tiepolo (q.v.). Fragonard first painted in a style suitable to his religious and historical subjects. After 1765, however, he worked in the style then fashionable in France, rococo (q.v.). These later paintings, the works for which he is best known, reflect the gaiety, frivolity and voluptuousness of the period. They are characterized by fluid lines, and gracefully posed figures. The French Revolution (q.v.), which destroyed the class on which Fragonard depended for commissions, ruined him financially. Although befriended by Jacques Louis David (q.v.), the leading painter of the period and head of the French classical school, Fragonard did not adjust to the new style and died in poverty.

His chief work was his decorations for the pavilion of Madame du Barry, mistress of Louis XV (qq.v.), King of France, at Louveciennes. The series that he executed there is known as "The

Progress of Love", and includes the paintings "The Pursuit" (1771-73) and "The Lover Crowned" (1771-73); these paintings are now in the Frick Collection, New York City. The Louvre in Paris has thirteen of his canvasses, among them "The Bathers" (about 1760) and "The Study" (1769). Other noted paintings of his are "The Swing" (about 1766, Wallace Collection, London) and "The Love Letter" (about 1769-70, Metropolitan Museum of Art, New York City).

FRAM. See NANSEN, FRIDTJOF.

FRAMBESIA. See YAWS

FRAMINGHAM, town of Massachusetts, in Middlesex Co., on the Sudbury R., 21 miles sw of Boston. It is served by two railroads and a municipal airport. The leading industries in Framingham are the manufacture of paper and paper products, carpets, chemicals, patent medicines, hats, rubber goods, and automobile

FRANC

parts. Framingham is the site of Massachusetts State College, a teacher-training institution. The college, established at Lexington, Mass., in 1839 and moved to Framingham in 1852, was an outgrowth of the first public normal school established in the United States. The town includes the village of Saxonville. It was settled about 1650, and was known as Danforth's Plantation until 1700, when it was incorporated under its present name. Pop. (1960) 44,526; (1970) 64,048.

FRANC, name applied to several modern currencies that serve as basic monetary units in France, Monaco, Belgium, Luxembourg, Switzerland, Liechtenstein, and several African nations that were once colonies of France and Belgium. The French and Swiss franc are the most important in international finance and commerce.

The original franc was a gold coin minted in France in 1360 by order of John II, King of France (see *under* JOHN), and acquired its name from a Latin inscription on its face reading: *Johannes Dei Gracia Francorum Rex* (John by the Grace of God King of the Franks). Similar coins, also known as francs, were minted by later French monarchs, but by the second quarter of the 15th century the franc had gone out of circulation. The name, however, was often applied to another French coin of the period, the *livre tournois*. The *livre* was abolished in 1795, and replaced by a silver franc equal to one hundred centimes. The modern French franc is derived from this coin.

During the present century the value of the French franc has undergone several drastic devaluations and one transformation to restore its value; see *DEVALUATION*. In 1914 its exchange value was U.S.\$0.1930, at which it was maintained by the French government throughout World War I (q.v.). During the 1920's and 1930's its value dropped steadily; in the early months of World War II it was worth about U.S.\$0.026, and continued to decline until on Dec. 26, 1945, the French government reduced its par of exchange value to U.S.\$0.0084. By the end of 1958, the exchange value of the franc was U.S.\$0.00202. On Jan. 1, 1960, the French government introduced the so-called heavy franc, worth 100 of the previous francs and having an official exchange value of U.S.\$0.2055. The heavy franc was later weakened by deficits in France's international balance of payments and was devalued in 1969 to U.S.\$0.18004. In 1975 it had a floating value of U.S.\$0.2289.

Since 1960 the fourteen African countries that were former French colonial areas have constituted a franc zone. Their Communauté Franco-Africaine franc (C.F.A.) has been pegged to

maintain a constant value in relation to the French franc and they altered the value of their franc in concert with French currency values. That arrangement began to change in the mid-1970's as international monetary relationships changed worldwide. (See *FOREIGN EXCHANGE*). In 1974 most of the eleven remaining C.F.A. countries decided to base their currency on a relationship to gold rather than the French franc. The French and the Belgian franc serve as two of the sixteen currencies that are components of the S.D.R., the monetary unit of the International Monetary Fund.

J.T.M.

FRANCE (Fr. *République Française*), republic of Europe, situated in the west-central region of the continental mainland and constituting, with certain overseas political divisions (see accompanying table), the principal component of the French Community; (see *COMMUNITY, THE*). Metropolitan, or continental, France is bounded on the N.W. and N. by the English Channel, the Strait of Dover, and the North Sea (which separate it from Great Britain); on the N.E. by Belgium, Luxembourg, and Germany; on the E. by Germany, Switzerland, and Italy; on the S.E. by the Mediterranean Sea; on the S. by Spain; and on the W. by the Bay of Biscay, an arm of the Atlantic Ocean. The country lies between about lat. 42°28' N. and lat. 51°21' N. and long. 8°16' E. and long. 5°12' W. France is approximately hexagonal in shape, with an extreme length from N. to S. of about 600 mi. and a maximum width of about 580 mi. The total area of metropolitan France, including the island of Corsica (q.v.) in the Mediterranean Sea, is 212,736 sq.mi.

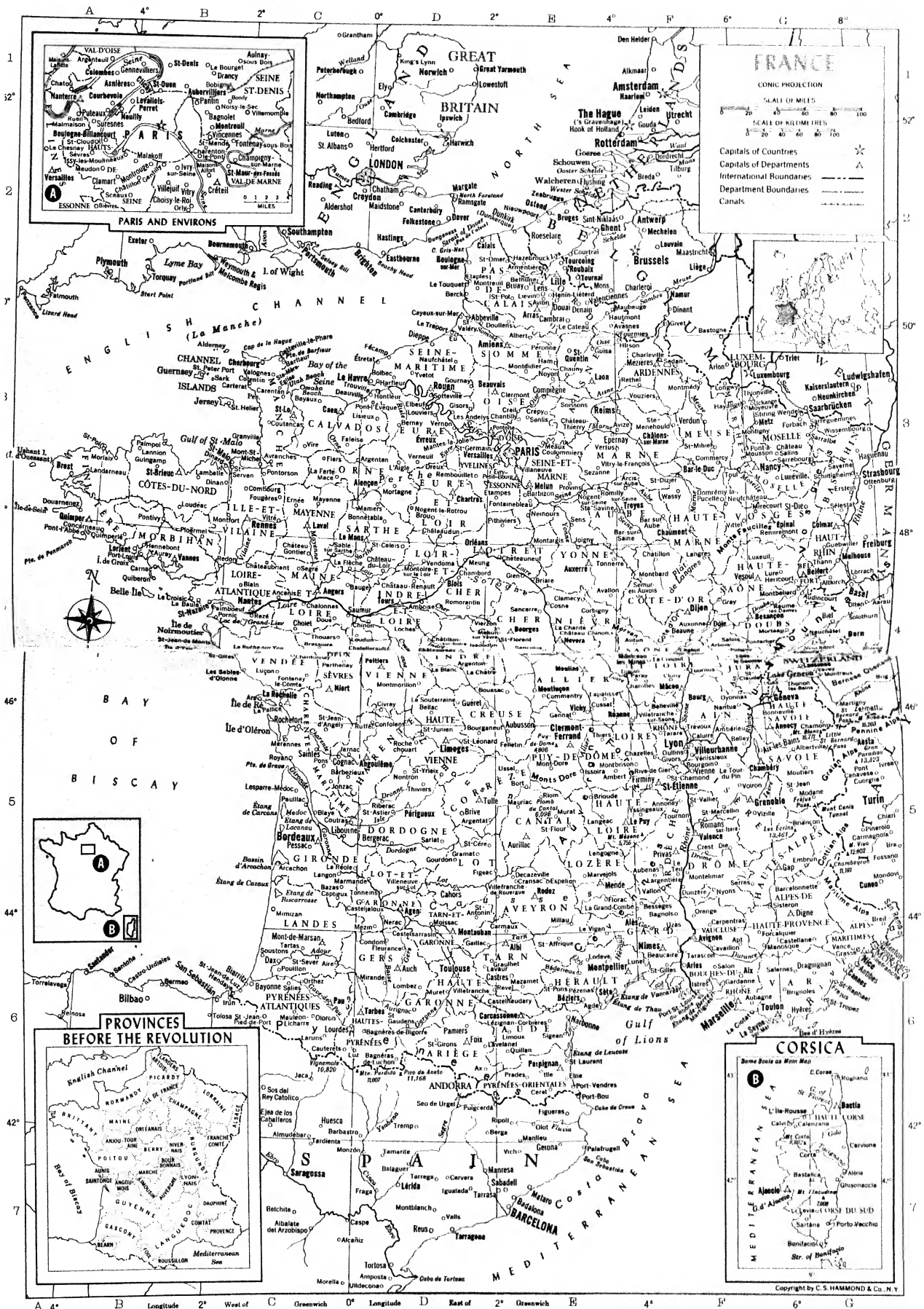
THE LAND

The chief physiographic features of France are its natural E. and S. boundaries, a south-central plateau, and, contiguous to the plateau, a vast region of rolling plains. A series of massive mountain ranges, including a number of ranges of the Alps and the Jura Mountains (qq.v.), form natural boundaries at the Franco-Italian and most of the Franco-Swiss borders. With flanking chains and foothills, these ranges dominate the area E. of the south-central plateau. Many of the Alpine mountains extending across and along the French border are more than 13,000 ft. above sea level; Mont Blanc (15,771 ft.) is the second-highest peak on the continent. The Jura Mts., which have a maximum elevation, on the Franco-Swiss boundary, of 5600 ft., delineate the eastern frontier of France from the east-west extension of the Rhone River (q.v.) valley to the Belfort gap, the broad depression linking the basins of the Rhine River and the Saône River (qq.v.). From the edge of the Belfort gap to the

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Continued on page 234



Le Tréport	D 2	Moulin	E 4	Remes	C 3	Schiltigheim	G 3	Vitry-sur-Seine	B 2	Liens (gulf)	F 6
Levallois-Perret	B 1	Moyeuve-Grande	G 3	Rezé	C 4	Sedan	F 3	Voron	F 5	Little Saint Bernard	G 5
Lézignan-Corbieres	C 5	Mulhouse	G 4	Riom	E 5	Salsat	G 3	Yvelot	D 3	(pass)	G 5
Libourne	E 2	Muret	D 6	Rive-de-Gier	F 5	Senlis	E 3			Loir (river)	G 4
Lille	E 2	Nancy	G 3	Roanne	E 4	Sens	E 3			Loire (river)	G 4
Limoges	D 5	Nanterre	A 1	Rochefort	C 4	Sète	E 6			Lot (river)	D 5
Limoux	E 6	Nantes	C 4	Rodez	E 5	Savres	A 2			Manche, La (English)	B 3
Lisieux	D 3	Narbonne	E 6	Romans-sur-Isère	F 5	Sossons	E 3	Adour (river)	C 6	(chan)	F 3
Longwy	F 3	Nemours	E 3	Romilly-sur-Seine	F 3	Sotheville les-Rouen	D 3	Ain (river)	F 4	Maritime Alps (range)	G 5
Long-le-Saunier	F 4	Neufchâteau	D 3	Romort-sur-Seine	D 4	Strim-Wendel	G 3	Aisne (river)	E 3	Marne (river)	C 2
Lorient	B 4	Neufchâteau-en-Bray	D 3	Roubaix	E 2	Strasbourg	G 3	Alaccio (gulf)	F 7	Mayenne (river)	E 7
Loudes	C 6	Neuilly-sur-Seine	B 1	Rouen	D 3	Suresnes	A 2	Alger (river)	E 5	Mediterranean (sea)	C 7
Louviers	D 3	Nevers	E 4	Royan	C 5	Tarare	F 6	Aube (river)	F 3	Médoc (reg)	E 6
Lunel	E 6	Nice	G 6	Ruill-Malmaison	A 2	Tarascon	F 6	Auvergne (mts)	E 5	Meuse (river)	F 3
Lunéville	G 3	Nîmes	F 6	Sablé-sur-Sarthe	C 4	Tarbes	D 6	Belle-Ile (isl)	B 4	Mont Cenis (tunnel)	F 5
Luxeuil-les-Bains	G 4	Niort	C 4	Saint-Amand	E 4	Thiers	E 3	Biscay (bay)	B 5	Monvan (plateau)	F 4
Lyon	D 3	Nogent-le-Rotrou	D 3	Mont-Rond	B 3	Thonville	G 5	Blanc (mt)	G 5	Moselle (river)	G 3
Lyon-la-Boissière	F 5	Nolay-le-Sec	B 1	Saint-Brieuc	F 5	Thonon-les-Bains	G 4	Bonifacio (strait)	G 7	Normoulter (isl)	B 4
Macon	F 4	Noyon	E 3	Saint-Chamond	F 4	Toul	F 3	Calais (strait)	D 2	North (sea)	E 1
Maisons-Alfort	A 1	Oron-Sainte-Marie	C 6	Saint-Claude	A 2	Toulon	F 6	Causse (region)	E 5	Orse (river)	E 3
Maisons-Laffitte	B 2	Orange	F 5	Saint-Cloud	B 1	Toulouse	D 6	Cévennes (mts)	E 5	Oleron, d' (isl)	C 3
Malakoff	G 6	Orléans	D 3	Saint-Denis	G 3	Tourcoing	E 2	Charente (river)	C 5	Omaha (beach)	E 6
Manosque	B 2	Orly	B 2	Saint-Dié	C 6	Tournus	F 4	Cher (river)	D 4	Orb (river)	C 3
Mantes-la-Jolie	D 3	Orthez	C 6	Saint-Dizier	C 3	Tours	D 4	Corse (cape)	G 6	Orne (river)	E 6
Marande	C 5	Oullins	F 5	Sainte-Mère-Eglise	C 5	Trouville-sur-Mer	C 3	Corsica (isl)	G 6	Ouessant (isl)	A 3
Marne-la-Tour	F 6	Oyonnax	F 4	Saintes	E 3	Troyes	F 3	Côte-d'Or (mts)	F 4	Perche (reg)	E 5
Martigues	F 6	Pamiers	D 6	Sainte-Savine	F 5	Tulle	D 5	Cottin Alps (range)	G 5	Puy-de-Dôme (mt)	C 4
Maubeuge	C 3	Paray-le-Monial	B 1	Saint-Etienne	D 6	Uzès	F 5	Creuse (river)	D 4	Pyrenées (range)	C 6
Mayenne	E 6	Paris (capital)	B 2	Saint-Gaudens	D 3	Valence	E 2	Dordogne (river)	E 5	Ré (isl)	G 4
Mazamet	E 3	Parthenay	C 4	Saint-Germain-en-Laye	C 6	Valenciennes	D 4	Doubs (river)	G 4	Rhone (river)	F 5
Meaux	E 5	Pau	E 3	Saint-Jean-d'Angély	G 5	Vandœuvre	F 5	Drôme (river)	F 5	Risle (river)	D 3
Melun	E 3	Pergueux	C 6	Saint-Jean-de-Luz	C 6	Vénissieux	F 3	Durance (river)	D 5	Saône (river)	F 4
Mende	E 6	Péronne	E 3	Saint-Jean-Pied-de-Port	G 5	Vernon	D 3	English (channel)	B 3	Sarthe (river)	C 3
Menton	G 6	Pessac	E 5	Saint-Lô	C 6	Versailles	A 2	Eure (river)	D 3	Saône (bay)	C 3
Metz	E 3	Pézénas	E 6	Saint-Malo	B 2	Vesoul	F 4	Fréjus (pass)	G 5	Seine (river)	E 4
Meudon	A 2	Pithiviers	D 4	Saint-Mandé	B 2	Vichy	E 4	Gard (river)	F 5	Sologne (reg)	E 4
Millau	E 5	Poitiers	E 3	Saint-Maur-des-Fossés	F 3	Vierzon	D 4	Garonne (river)	C 5	Somme (river)	D 2
Montargis	E 3	Poitiers	D 4	Saint-Nazaire	B 4	Villefranche-de-Rouergue	E 5	Gave-de-Pau (river)	C 6	Tarn (river)	E 6
Montauban	D 5	Pont-à-Mousson	G 3	Saint-Omer	E 2	Villefranche-sur-Saône	F 4	Gers (river)	D 6	Uran (beach)	F 6
Montbard	F 4	Pontarlier	G 3	Saint-Ouen	B 1	Villejuif	B 2	Grande (river)	C 5	Vienne (river)	D 4
Montbéliard	G 4	Portarlier	G 3	Saint-Quentin	E 3	Villeneuve-Saint-Georges	C 1	Graian Alps (range)	G 5	Vilaine (river)	D 4
Montbrison	E 5	Portivy	G 4	Saint-Raphaël	G 6	Villeneuve-sur-Lot	E 3	Hague (cape)	B 4	Vosges (mts)	C 4
Montceau-les-Mines	F 4	Portivy	G 4	Saint-Valéry-sur-Somme	D 2	Villeneuve-sur-Lot	F 5	Hérault (river)	E 6	Yeu,d' (isl)	B 4
Mont-de-Marsan	C 6	Port-Saint-Louis-du-Rhône	F 6	Salon-de-Provence	G 3	Villeneuve-sur-Lot	D 5	Indre (river)	D 4	Yonne (river)	E 3
Mont-Dore	E 5	Port-Vendres	E 6	Sarrebourg	F 6	Vincennes	B 2	Isère (river)	F 5		
Montélimar	F 5	Provins	E 3	Sarraguenmes	G 3	Vire	C 3	Isle (river)	D 5		
Montfort	C 3	Puteaux	A 2	Saumur	D 4	Vitré	C 3	Jura (mts)	F 4		
Montigny-les-Metz	E 4	Quiberon	B 4	Savenn	E 3	Vitry-le-François	F 3	Langres (plateau)	F 4		
Montluçon	E 6	Quimper	A 4	Saverne	G 3			Limoges (region)	D 5		
Montpeilier	B 2	Quimper	B 4	Saverne	G 3						
Montreuil	B 2	Quimper	B 4	Saverne	G 3						
Montrouge	B 2	Quimper	B 4	Saverne	G 3						
Mont-Saint-Michel	C 3	Reims	E 3	Saverne	G 3						
Mortaux	B 3	Remiremont	G 3	Sceaux	A 2						



France. Plate 1. The Château Chambord, in the Loire Valley in north-central France. The Renaissance castle, the largest and one of the most beautiful of the Loire châteaux, was built by Francis I in the early 16th century

Pictures, Plates 1 and 2 French Government Tourist Office



France. Plate 2. Above: A typical half-timbered farmhouse in the historic province of Normandy. The original Normans were pagan Norsemen, whose descendants adopted Christianity and became a powerful force in European history. Left: Women of Brittany in traditional costume. Brittany is the only region of France with a language of its own in addition to French: the Breton language, which is a division of Celtic.

Opposite page: The Seine River flows through Paris on its way to the English Channel. This bridge, one of thirty-two that cross the river in Paris, provides access to the small boat-shaped island known as the Ile de la Cité. In the center background, on the island, can be seen the spires of the 12th-century Cathedral of Notre Dame de Paris.

Doisneau-Rapho-Photo Researchers

ne corner of France, the Franco-German border is formed by the Rhine River (qv). The Vosges Mountains (qv.), extending n from the Belfort gap, dominate the region between the Moselle River (qv) and the Rhine. The highest elevations in the Vosges Mts. reach 4700 ft. The Pyrenees (qv), which extend along the Franco-Spanish frontier from the Mediterranean Sea to the Bay of Biscay, form the other mountain boundary of France. Vignemale Mt. (10,820 ft.) is the highest French peak in the Pyrenees. The Pyrenees are traversed by few passes, a circumstance that has traditionally hampered commerce between France and Spain. However, the Alpine and other ranges in the e are broken by gaps and passes, notably the passes of Saint Bernard (qv).

The south-central plateau is separated from the eastern highland region by the valley of the Rhône R. This elevated region has an irregular relief and conformation. The plateau, rising gradually from the plains region on the n and w, is characterized by volcanic outcroppings, by deeply eroded limestone tablelands to the s

of the region of extinct volcanoes, and farther to the s, by the Cevennes (qv.), a series of highlands rising from the Mediterranean coastal depressions.

The plains region, by far the most extensive section of the terrain of France, is a projection of the Great Plain of Europe (see EUROPE: *The Land*). Except for a few hilly outcroppings, chiefly in the west-central portion, the French plains consist of gently undulating lowlands, with an elevation of about 650 ft. above sea level. The outstanding features of the plains region, the most fertile in France, are the valleys of the Seine, Loire, and Garonne (qqv.) rivers. Together with numerous tributaries, these rivers drain the Atlantic watershed of France. The Rhône R. is the largest in France in terms of volume of discharge. With its tributaries, particularly the Saône, Isère, and Durance rivers, it drains the French Alpine region. Among the principal tributaries of the Seine R., which is the main artery of the national inland waterway system, are the Aube, Marne, Oise, and Yonne rivers. Nearly all of the French streams, totaling





A peaceful street scene in Florac, a typical small provincial town of some 1800 inhabitants in the Gard Department of southern France.

Victor Englebert-Photo Researchers

more than 200, are commercially navigable for varying distances. France has only a few lakes. Lake Geneva (see GENEVA, LAKE), situated on the Franco-Swiss frontier, belongs mainly to Switzerland.

The coastline of France, although about 1950 mi. long, has relatively few natural harbors. The N.W. coast, along the English Channel and the North Sea, is about 700 mi. long and is broken by a number of promontories, river estuaries, and minor indentations, few of which provide safe anchorages. Le Havre harbor is the one outstanding exception. As at Cherbourg (q.v.), a number of harbors have been formed in this region by the construction of breakwaters. The western coastline of France along the Atlantic, including the Bay of Biscay, is 865 mi. long. From the Brittany peninsula to the Gironde Estuary (q.v.), the Atlantic coastline of France is irregular in outline, and, except in Brittany, is low and sandy. The principal harbors on this part of the coast are those of Brest, Lorient, and Saint-Nazaire. Bordeaux is inland on the Gironde. South-

ward of the Gironde, the coastline consists of an almost continuous stretch of dunes, bordered by arid moors. The best natural harbors of France, including the harbors of Marseille, Toulon, and Nice, are on the Mediterranean. However, a major part of the French Mediterranean coast, which is about 385 mi. long, is bounded by rocks or shallow water.

Climate. The climate of France is generally temperate, but wide regional contrasts occur, as in the Mediterranean coastal area, where semi-tropical conditions prevail, and in the plateau and eastern highlands regions, where the climate is uniformly bleak. Temperatures along the Atlantic seaboard are equalized by ocean currents and the prevailing S.W. winds. In the interior, particularly the N.E. region, severe winters and hot summers are usual. The mean annual temperature is about 57° F. at Nice, 50.5° F. at Paris, and 48° F. at Nancy. Precipitation is quite evenly distributed throughout France, averaging about 30 in. annually. The heaviest rainfalls occur in June and October. Regional variations in precipitation range between 55 in. annually in the mountainous areas and 10 in. annually in certain northern lowland areas. One of the meteorological peculiarities of southern France is

the mistral, a violent northerly wind of the Mediterranean region, originating in the central plateau region.

Natural Resources. France is richly endowed with an excellent balance of both mineral and agricultural resources. The nation is among the ten leading producers in the world of both iron ore and coal. In addition, France has sizable deposits of antimony, bauxite, magnesium, pyrites, tungsten, salt, potash, radioactive materials, lead, and zinc. Production of natural gas and sulfur is being developed. Large fertile regions, along with a favorable climate and a tradition of skilled farming and animal husbandry, have produced an agricultural economy that is thriving.

Plants and Animals. The native plant life of France shows the variety characteristic of continental Europe. It ranges from arctic-alpine lichens and mosses to such semitropical species as the olive and orange trees. Various species of both coniferous and deciduous trees are found in the forests, which cover about 29,000,000 acres, or one sixth of the area of France. The principal forest trees are the chestnut, beech, oak, cork, walnut, fir, and pinaster. Like that of western Europe generally, the fauna of France includes few specimens of the larger mammals; the most common of these are the deer and the fox. The chamois is found in the higher Alpine

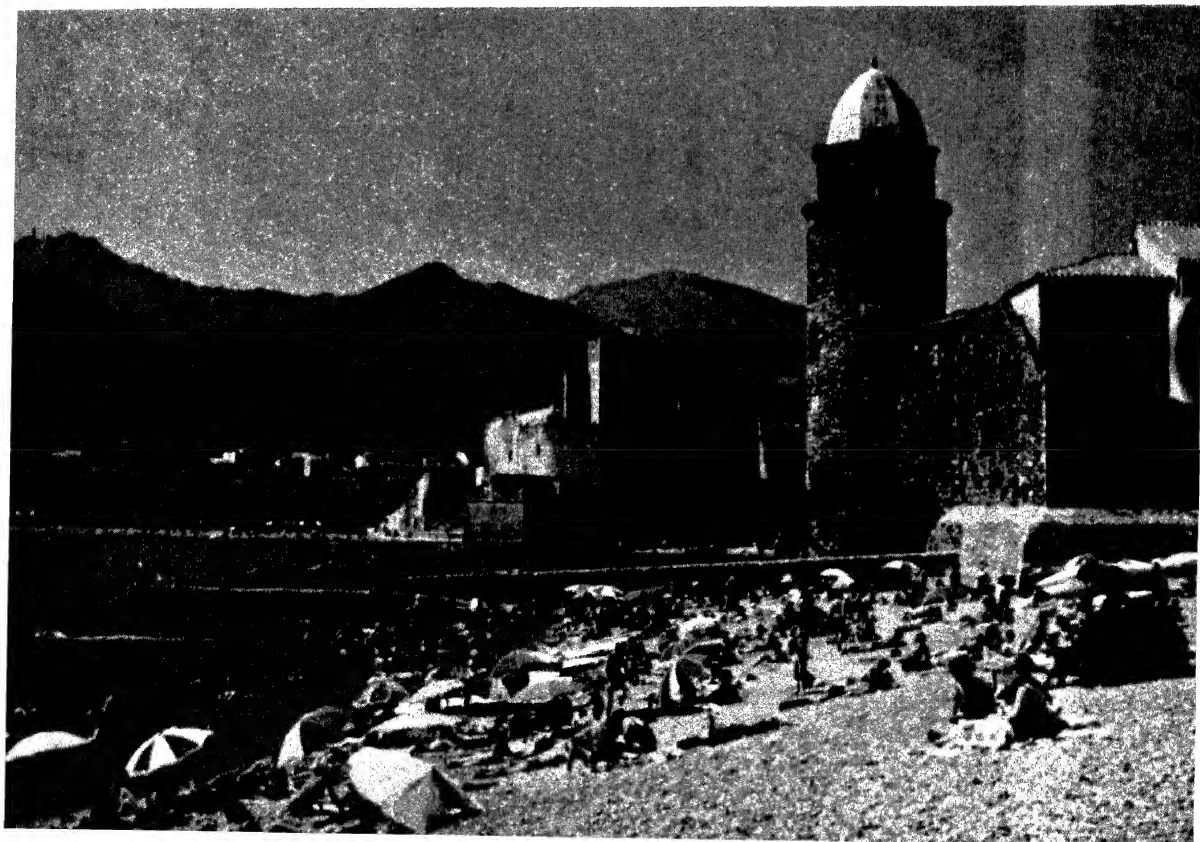
regions, and the wolf and wild boar survive in remote forest areas. Among the smaller animals are the porcupine and several carnivores of the weasel family. France has a wide variety and abundance of birdlife, including both indigenous and migratory species. Reptiles are rare, and the only venomous type is the adder (q.v.). Cyprinoids are the most characteristic freshwater fishes found in France. The Atlantic and Mediterranean coastal waters contain numerous species of fish, including cod, herring, whiting, mackerel, flounder, sardine, and tuna.

Soils and Waterpower. France has extensive tracts of fertile soils, the richest of which are the marine sediments of the Paris Basin and the well-watered alluvial soils of the lower valleys of the Seine and Somme rivers.

Total power production in 1971 equaled about 149,000,000,000 kw hours. Approximately 33 percent of this figure was produced hydroelectrically. The world's first tidal power plant, on the Rance R., in Brittany, began operation in 1966. Nearly all major generating facilities, including nuclear-power plants, are operated by Electricité de France, which is the state power authority.

Collioure, on the southern coast of France, near the Spanish border, is a seaside resort and fishing port. Its ancient-looking fortifications were built in the 12th century.

Luis Villota-Photo Researchers





M Monester-Photo Researchers

France. Plate 3. Above Skill in horsemanship is taken for granted on La Camargue, an island in the Rhone delta in southeastern France where cattle are raised. The cowboys are known as gardiens. Below Workers gather flowers in the rose gardens near Grasse, in the Alpes-Maritimes Department of southeastern France. Grasse has long played a prominent role in the country's perfume industry.

Jacques Jangoux-Photo Researchers



DEPARTMENTS OF FRANCE (1975 census)

Department	Population	Capital	Department	Population	Capital
AIN	376,477	Bourg	ILLE-ET-VILAINE	702,199	Rennes
AISE	533,862	Laon	INDRE	248,523	Châteauroux
ALLIER	378,406	Moulins	INDRE-ET-LOIRE	478,601	Tours
ALPES-DE-HAUTE-PROVENCE	112,178	Digne	ISERE	860,378	Grenoble
ALPES-MARITIMES	816,681	Nice	JURA	238,856	Lons-le-Saunier
ARDÈCHE	257,065	Privas	LANDES	288,323	Mont-de-Marsan
ARDENNES	309,306	Mézières	LOIRE	742,396	Saint-Étienne
ARIÈGE	137,857	Foix	LOIRE-ATLANTIQUE	934,499	Nantes
AUBE	284,823	Troyes	LOIRET	490,189	Orléans
AUDE	272,366	Carcassonne	LOIR-ET-CHER	283,686	Blois
AVEYRON	278,306	Rodez	LOT	150,725	Cahors
BAS-RHIN	882,121	Strasbourg	LOT-ET-GARONNE	292,616	Agen
BELFORT, TERRITOIRE DE	128,125	Belfort	LOZÈRE	74,825	Mende
BOUCHES-DU-RHÔNE	1,632,974	Marseille	MAINE-ET-LOIRE	629,849	Angers
CALVADOS	560,967	Caen	MANCHE	451,662	Saint-Lô
CANTAL	166,549	Aurillac	MARNE	530,399	Châlons-sur-Marne
CHARENTE	337,064	Angoulême	MAYENNE	261,789	Laval
CHARENTE-MARITIME	497,859	La Rochelle	MEURTHE-ET-MOSELLE	722,587	Nancy
CHER	316,350	Bourges	MEUSE	203,904	Bar-le-Duc
CORRÈZE	240,363	Tulle	MORBIHAN	563,588	Vannes
CORSE-DU-SUD	121,771 ¹	Ajaccio	MOSELLE	1,006,373	Thionville
CÔTE-D'OR	456,070	Dijon	NIÈVRE	245,212	Nevers
CÔTES-DU-NORD	525,556	Saint-Brieuc	NORD	2,510,738	Lille
CREUSE	146,214	Guéret	OISE	606,320	Beauvais
DEUX-SÈVRES	335,829	Niort	ORNE	293,523	Alençon
DORDOGNE	373,179	Périgueux	PARIS, VILLE-DE-PAS-DE-CALAIS	2,299,830	Paris
DOUBS	471,082	Besançon	PUY-DE-DÔME	1,403,035	Arras
DRÔME	361,847	Valence	PYRÉNÉES-ATLANTIQUES	580,033	Clermont-Ferrand
ESSONNE	923,061	Évry	PYRÉNÉES-ORIENTALES	534,748	Pau
EURE	422,952	Évreux	RHÔNE	299,506	Perpignan
EURE-ET-LOIR	335,151	Chartres	SAÔNE-ET-LOIRE	1,429,647	Lyon
FINISTÈRE	304,088	Quimper	SARthe	569,810	Macon
GARD	494,575	Nîmes	SAVOIE	490,385	Le Mans
GERs	175,366	Auch	SEINE-ET-MARNE	305,118	Chambéry
GIRONDE	1,061,474	Bordeaux	SEINE-MARITIME	755,762	Melun
HAUTE-CORSE	148,060 ¹	Bastia	SEINE-ST-DENIS	1,172,743	Rouen
HAUTE-GARONNE	777,431	Toulouse	SOMME	1,322,127	Bobigny
HAUTE-LOIRE	205,491	Le Puy	TARN	538,462	Amiens
HAUTE-MARNE	212,304	Chaumont	TARN-ET-GARONNE	338,024	Albi
HAUTES-ALPES	97,358	Gap	VAL-DE-MARNE	183,314	Montauban
HAUTE-SAÔNE	222,254	Vesoul	VAL-D'OISE	1,215,674	Crétail
HAUTE-SAVOIE	447,795	Annecy	VAR	840,885	Pontoise
HAUTES-PYRÉNÉES	227,222	Tarbes	VAUCLUSE	626,093	Toulon
HAUTE-VIENNE	352,149	Limoges	VENDEE	390,446	Avignon
HAUT-RHIN	635,209	Colmar	Vienne	450,641	La Roche-sur-Yon
HAUTS-DE-SEINE	1,438,930	Nanterre	VOSGES	357,366	Poitiers
HÉRAULT	648,202	Montpellier	YONNE	397,957	Épinal
			YVELINES	300,071	Auxerre
				1,082,255	Versailles

OVERSEAS DEPARTMENTS AND TERRITORIES OF FRANCE

Overseas Departments	Area (sq. mi.)	Population	Overseas Territories	Area (sq. mi.)	Population
Guadeloupe	657	324,530 ²	French Polynesia	1545	130,000 ³
French Guiana	23,000	55,125 ²	New Caledonia	7374	131,700 ²
Martinique	420	324,832 ²	Southern and Antarctic Territories	2842	*
Réunion	969	476,675 ²	Wallis and Futuna Islands	106	9,000 ²
Saint Pierre and Miquelon	93	5,800 ²			

*Uninhabited, used for scientific research stations.

¹ 1968 census ² 1974 census ³ 1975 est.

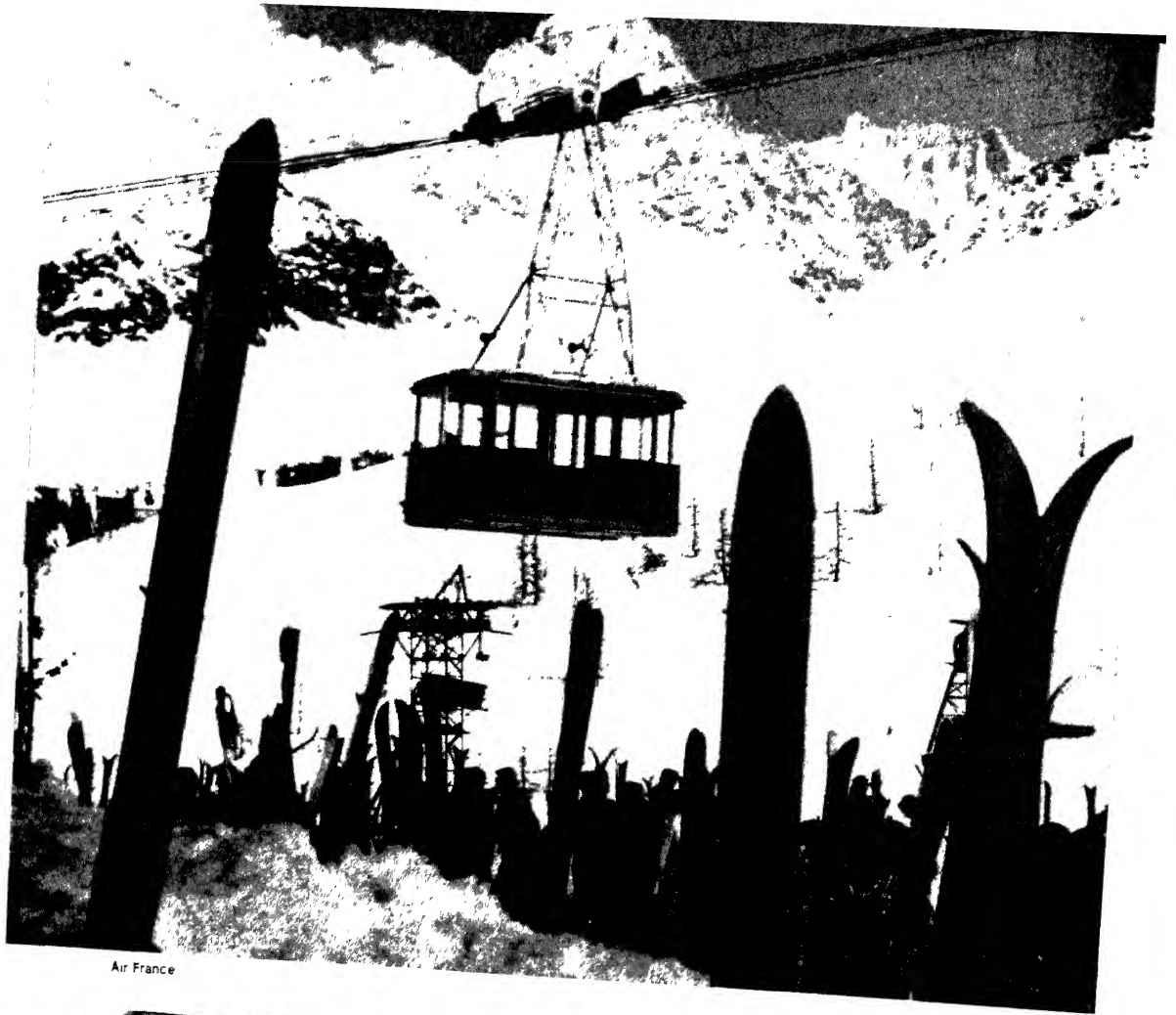
THE PEOPLE

More than 85 percent of the French are native-born, and the population is mostly of the Caucasian race (q.v.). The largest foreign-born groups are Italians (about 1,000,000), Spaniards, Portuguese, Poles, and North Africans.

Population. The population of France (census

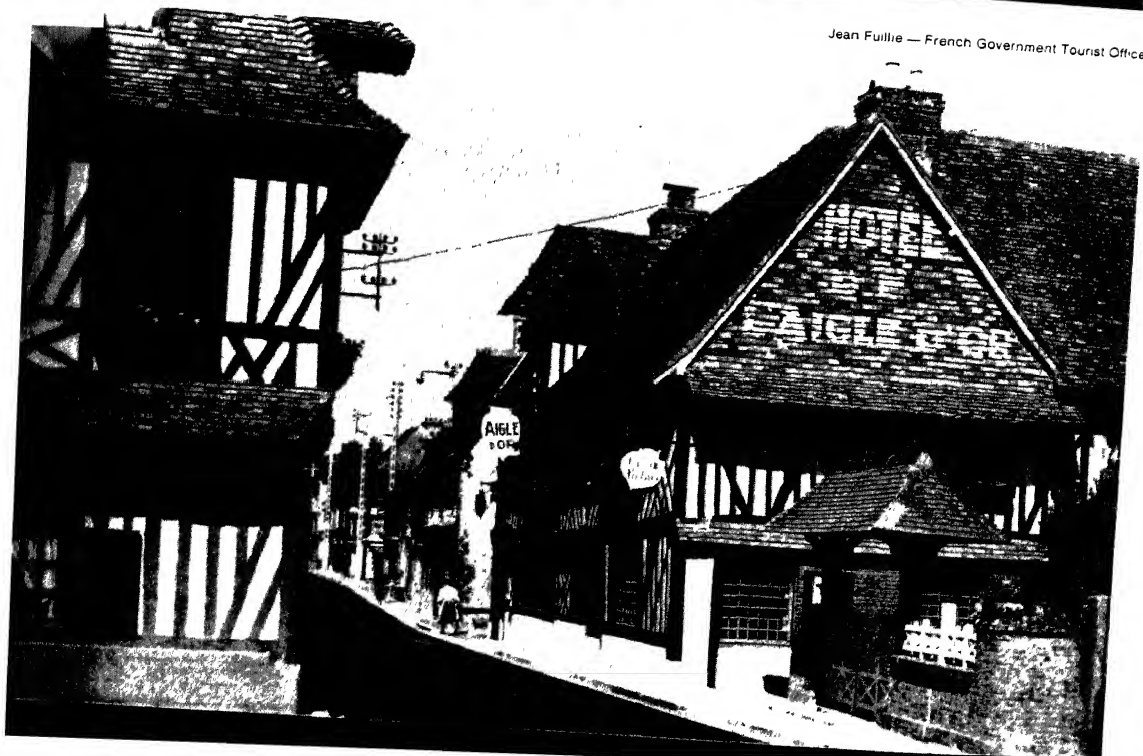
1975) was 52,658,253, the United Nations estimated (1976) 52,915,000. The overall population density is about 251 per sq. mi. (U.N. est. 1975). More than 70 percent of the population is classified as urban.

Political Divisions. Metropolitan France is composed of ninety-six political divisions, called



Air France

Jean Füllie — French Government Tourist Office



departments, many of which are described in individual articles. See accompanying chart listing departments and their capitals, and the section *Government: Local Government*, below.

Principal Cities. The capital and largest city of France is Paris (q.v.), which has a population (1968 census) of 2,580,010. Marseille (813,000) is the chief port, and Lyon (524,600) is an industrial center, specializing in textiles. Other major cities, with their populations, are Toulouse (369,200), an industrial and trade center; Nice (319,937), a resort; Bordeaux (264,184), a seaport and wine and industrial center; Nantes (256,917), noted for sugar refining, shipbuilding, and a variety of other industries; Strasbourg (247,918), a Rhine R. port and industrial and commercial center; and Saint-Étienne (212,939), a producer of armaments, iron and steel, ribbons, and other manufactured goods. An additional twenty-six cities have populations of over 100,000.

Religion. Roman Catholicism is the faith of about 90 percent of French churchgoers. Protestantism and Judaism are next in importance. After 1801 these three religions were subsidized by the state. In 1905, because of popular opposition to the political influence of the Roman Catholic Church and to Catholic control of public education, legislation prohibited the payment of public funds to the Roman Catholic, Protestant, and Jewish clergy. By the provisions of that and subsequent legislation, the French government withdrew official recognition of religious denominations.

Language. Excluding Brittany (q.v.), where Breton (see BRETON LANGUAGE AND LITERATURE) is still spoken, the language employed by the overwhelming majority of the people is French, one of the Indo-European family of languages (see FRENCH LANGUAGE).

Education. French education has had a far-reaching influence throughout its long history. French centers of learning, beginning with the French universities of the Middle Ages, particularly the University of Paris at the Sorbonne, founded in 1253, and continuing down to the modern French universities and technical schools, all have served as academic models throughout the world. Among the French educators who have exerted notable influence are Peter Abelard in the 12th century, Michel Eyquem de Montaigne in the 16th century, François de Salignac de la Mothe Fénelon and Jean

Jacques Rousseau in the 18th century, and Victor Cousin (qq.v.) in the 19th century.

The centralization of school administration, with the state as the fundamental power in education, evolved under the leadership of Napoleon I between 1806 and 1808. The modern educational system is based on the laws of Jules François Camille Ferry (1832–93), Minister of Education, which were enacted between 1881 and 1886. These laws provided for free, compulsory education entirely under government control. Among later modifications were the establishment of free tuition in secondary and technical schools; the separation of church and state in education in 1905; the legislation of aid to private schools, including those with religious affiliations, in 1951 and 1959; and, in 1959, the extension of compulsory school attendance to the age of sixteen. In response to strong student demands, educational reforms were approved in 1968 by President de Gaulle and his cabinet. Specifically, the new system did away with the control of budgets, curricula, and hiring throughout the nation by the ministry of education. Instead, it established educational units at various levels, gave faculties control of hirings and promotions, and gave students a greater voice in university life. The authority of university professors occupying lifetime chairs to vote on new appointments was abolished, and establishment of more democratic departmental structures on a subject basis was indicated for universities.

ELEMENTARY AND SECONDARY SCHOOLS. In the early 1970's, some 7,350,000 students annually attended more than 74,000 elementary and preelementary schools. Approximately 8900 of these schools were privately operated. In addition, about 1,700,000 students attended public secondary schools, and about 500,000 attended private secondary schools. Approximately 885,000 students annually attended technical and professional training schools.

UNIVERSITIES AND COLLEGES. Approximately 646,000 students were enrolled annually at university and college facilities in the early 1970's. France had 23 centers of higher education during that period, including the University of Paris (see PARIS, UNIVERSITY OF), with an annual enrollment of about 188,000. About 5 percent of French youth receive university degrees.

Culture. The culture of France has profoundly influenced that of the entire Western world, particularly in the areas of art and letters, and Paris has long been regarded as the fountainhead of French culture. This stature results, in part, from the long period during which France

Opposite page: Cable cars (above) at Chamonix, the principal means of ascent to the peak of Mont Blanc. A quiet street (below) in Pont-l'Évêque, a typical small town of Normandy.



A young Frenchwoman gazes at the "Venus de Milo" in the Louvre.

was the center of the Holy Roman Empire, and later, to the wealth of the French crown in the 17th and 18th centuries, which provided a subsidization of art on a scale comparable to that of the papacy in Rome, attracting to Paris many of Europe's most talented artists and artisans. Wealth also created a leisure class, which had both time and the means for developing elegance in dress, manners, furnishings, and architecture. French styles still pervade much of Western culture. In the 20th century French cinematography assumed a leading world position, particularly with the so-called new wave of experimental motion pictures (q.v.). See FRENCH ART AND ARCHITECTURE; FRENCH LITERATURE; FRENCH MUSIC.

LIBRARIES AND MUSEUMS Most provincial cities in France have municipal libraries and museums. The largest concentration of such facilities is, however, in Paris. Of the 652 libraries in France, 78 are in Paris; these include the National Library, founded in 1480, which has a collection of more than 10,000,000 books, manuscripts, prints, maps, and periodicals. The Louvre, also in Paris, contains one of the largest and most

important art collections in the world. Many of the great masterpieces of French architecture, such as churches, cathedrals, castles, and châteaux, are maintained as national monuments. **ARCHEOLOGY** In France archeologists have uncovered the most complete record of human habitation found to date in Europe. The finds range from Fonté Chevade, where a skull and artifacts indicate near-human habitation some 100,000 years ago, to the Greek settlements at Massilia (Marseille) and Cayla de Mailhac, on the Mediterranean, and remnants of the Roman conquest (123–121 B.C.) at Alesia, Gergovia, Saint-Chamas, Arles, Tongres, Nîmes, and Orange. Archeological surveys have uncovered evidence of fire-using cave dwellers, about 40,000 years ago, at Le Moustier and Les Eyzies, among other sites, and of open settlements, dating back some 10,000 years, the inhabitants of which were skilled with bow and arrow. Evidence of Danubian, Hallstattian, and La Tène cultures has also been unearthed.

THE ECONOMY

France, once primarily agricultural, has become increasingly industrialized since World War II. During that period, the government instituted a series of wide-ranging plans designed to foster national recovery and increase governmental direction of the economy. Included in the so-called Monnet Plans was the principle of nationalization of certain industries, notably railroad and air transportation systems, major banks, and coal mines. The government, in addition, became a major shareholder in the automotive, electronics, and aircraft industries, as well as the primary investor in the development of both oil and natural-gas reserves. Partly as a result of such plans and programs, the gross national product of France increased by nearly 50 percent between 1949 and 1954, by 46 percent between 1956 and 1964, and at an average annual rate of 3.9 percent during 1970–75. Budget estimates for 1978 showed some \$79 billion in revenue and slightly higher expenditure.

Agriculture. About 30 percent of the total area of France is under cultivation, and about 10 percent of the labor force is engaged in agricultural pursuits. Under normal conditions French farms, which are mainly small-scale enterprises averaging about 36 acres each, produce sufficient cereal grains and other basic foodstuffs for national domestic needs. A valuable product of the soil is the wine grape. France and Italy lead the world in the production of wine; French output in 1975 was 1.81 billion gal. See WINE: *Foreign Wines*; *French Wines*.

Production of the principal field crops in the

mid-1970's included sugar beets (22,860,000 tons), wheat (15,040,000 tons), potatoes (7,230,000 tons), and barley (9,340,000 tons). Other important field crops are rye, oats, turnips, artichokes, flax, hemp, and tobacco. In some parts of the country silk culture is important. Horticulture figures prominently in the economy of the French countryside, and large crops of eating and cider apples, pears, plums, peaches, apricots, berries, cherries, olives, citrus fruits, and nuts are harvested. Pastoral enterprises are also an important source of farm income. In the mid-1970's livestock on the farms of France included about 24,250,000 cattle, 10,710,000 sheep, 12,030,000 pigs, 402,000 horses, and 942,000 goats, as well as several kinds of poultry.

Forest and Fishing Industries. Of a total of about 36,820,000 acres of forest lands, some two thirds are privately owned. About 70 percent of the forests consists of oak, beech, and poplar. Production of roundwood in the mid-1970's averaged about 1.01 billion cu.ft. annually. Resin, turpentine, and cork are also important.

About 32,200 fishermen are employed on the 13,000 French fishing craft that ply coastal waters and the high seas. In the mid-1970's the sea catch totaled about 782,000 tons annually and was valued at more than \$588,000,000. The catch included about 550,000 tons of various species of fish, 35,300 tons of shellfish, and 94,000 tons of oysters. Herring, cod, hake, coalfish, and tuna are the chief catch.

Mining. France has a broad diversity of mineral deposits. Coal reserves, located mainly in the north, are estimated at 1.4 billion tons; coal production amounted to more than 26,830,000 tons annually in the mid-1970's. French iron-ore deposits are among the richest in the world, and annual production totals about 49,700,000 tons. Production of bauxite increased from 880,000 tons annually in the early 1950's to about 2,600,000 tons each year in the mid-1970's. Small deposits of petroleum are located in the Landes region in the southwest. Annual production of petroleum totaled about 1,000,000 tons and of natural gas about 267.47 billion cu.ft. Lignite, pyrites, potash salts, salt, and lead are also mined in France in significant quantities.

Manufacturing. The manufacturing industries of France compare favorably, in volume, variety, and quality of output, with those of other nations of Western Europe. Among industries producing durable goods (other than metals), the manufacturing of automotive vehicles ranks high; the output of vehicles reached about 3,300,000 annually in the mid-1970's; the largest manufacturer of automobiles in France is the

nationalized Renault works. Other durable goods produced in large quantity in France are airplanes, household appliances, machinery, and chemicals. Steel production is over 21,500,000 tons yearly. The French spinning and textile industry is among the largest in the world; the annual production of cloth woven from wool, cotton, silk, and synthetic fibers is more than 288,400 tons. Sugar-beet refining is another important industry, as are food processing, liquor distilling, and the manufacture of various specialized products. In the last-named field, several branches of French industry are internationally renowned for the quality of the articles produced, such as perfumes, gloves, lace, women's hats, women's clothing, tapestry, shawls, clocks, china, glass articles, pottery, furniture, and numerous other luxury items. Operative nuclear plants produced about 17.45 billion kw hours of electricity annually in the mid-1970's, and additional nuclear plants were scheduled to begin operations later in the decade.

Currency and Banking. The franc, equal to 100 centimes, is the basic unit of currency of France. The French franc is convertible (4.54 francs equal U.S.\$1; 1978). The Banque de France, founded in 1800 and nationalized in 1946, is the bank of issue. Some 300 commercial banks, including branches of foreign banks, operate more than 3000 branches throughout France. Although the three largest deposit banks have been nationalized, most banking services are provided by privately owned institutions.

Commerce and Foreign Trade. Paris is the leading center of France's domestic and foreign trade, but other large cities, such as Marseille and Lyon, also play an important role in the country's commercial life. French commerce has long been characterized by a preponderance of small shops, and in the mid-1970's most stores were still of the privately owned, small-scale variety, despite a growing trend for big department stores and supermarkets to displace more modest outlets.

France is one of the world's great trading nations, and its foreign commerce includes a wide variety of goods. In the mid-1970's the country imported more than it exported each year, mainly because of its heavy foreign purchases of crude petroleum. In 1977 French imports cost \$70.5 billion and were made up chiefly of crude oil, food and live animals, machinery, chemicals, iron and steel, transport equipment, and various other manufactured items, such as precision instruments, clothing, and textiles. In the same year the country's exports earned \$63.6 billion. They included machinery, transport equip-

FRANCE

ment, chemicals, iron and steel, food and live animals, refined petroleum, clothing, textiles, and wine. About half of France's foreign trade is with fellow members of the European Economic Community (q.v.), especially West Germany, Belgium-Luxembourg, and Italy; the United States and Saudi Arabia also are important trade partners. France plays a leading role in the foreign commerce of some of its former overseas possessions, such as Morocco, Tunisia, and the Ivory Coast.

Transportation. France has one of the most highly developed transportation systems in Europe. The nation has more than 21,000 mi. of national highways, about 204,000 mi. of departmental roads, and about 264,000 mi. of local roads. In the mid-1970's more than 17,400,000 motor vehicles were in use; approximately 15,300,000 of these were passenger cars. The French railroads were nationalized in 1938. In the mid-1970's there were about 21,600 mi. of railroad track, about 27 percent of which was electrified. Some 658,000,000 passengers and 219,000,000 tons of freight were carried yearly. France has about 5350 mi. of navigable inland waterways, including some 2750 mi. of canals. The French merchant marine, one of the world's largest, comprises about 500 vessels of more than 100 gross tons. France has two state-run airlines: Air France, which operates flights to most parts of the world; and Air-Inter, which offers service within the country. There is one large private international airline, Union de Transports Aériens (U.T.A.), and several small private companies offering national and international service.

Communications. The French postal, telegraph, and telephone systems are operated by the government. Some 13,830,000 telephones were in operation in the mid-1970's. Radio and television services are also conducted by the government and are partly financed through users' license fees. Three television channels were in operation in the mid-1970's, serving about 12,340,000 receivers.

In the mid-1970's France had 103 daily newspapers, with a total circulation of about 11,460,000. The most influential newspapers are published in Paris. These include *Le Monde* (circulation 432,000), *Figaro* (350,000), *L'Aurore* (290,000), *France-Soir* (727,000), and *Le Parisien Libéré* (786,000). The country's leading periodicals include *Paris-Match* (circulation 645,000), *L'Express* (585,000), *Le Canard Enchaîné* (500,000), *Le Nouvel Observateur* (450,000), *L'Echo de Notre Temps* (876,000), and *Elle* (412,000).

Labor. In accordance with the latest available statistics, the labor force totaled about 22,130,000 persons in 1976. Of these, approximately 6,320,000 were members of labor unions. Some 2,400,000 belong to the Confédération Générale du Travail (C.G.T.), the largest labor organization in France. The Confédération Française Démocratique du Travail (C.F.D.T.), a Catholic-oriented organization, has some 820,000 members, and the Force Ouvrière has about 850,000 members. Minimum wages are established by government decree, but pay scales are determined by collective bargaining. The government administers comprehensive insurance programs for workers. About 1,145,000 persons were unemployed in late 1977.

GOVERNMENT

The governmental system of France is based on the constitution that was promulgated on Oct. 4, 1958. This document reduces the power of parliament to overthrow cabinets and markedly enlarges the authority of the president. It vests the sovereignty of the republic in the French people, who can exercise their political power through a representative parliament as well as through referenda. The French parliament consists of the National Assembly and the Senate. The former body is elected by equal and direct universal suffrage on the basis of the majority vote attained in the electoral constituency; the Senate is chosen by indirect popular suffrage, that is, by the membership of other representative bodies. The constitution of 1958 established a new body, the Constitutional Council, which has general power to supervise elections and referenda and to decide constitutional questions; the council consists of nine appointed members and all former presidents of the republic.

Central Government. The president of France is elected for a seven-year term by direct popular vote. (He was chosen by an electoral college of governmental bodies until 1962, when a constitutional amendment changed the method of presidential election.) The president is commander of the armed forces and presides over the Executive Council of the Community, the High Council of the Judiciary, the Committee of National Defense, and the Council of Ministers (cabinet). He designates the premier and appoints cabinet ministers on the recommendations of the premier.

The premier and the Council of Ministers are responsible only to the National Assembly, although the premier has the right to ask the Senate for approval of a general declaration of policy. When the National Assembly adopts a

motion of censure, or when it disapproves the program or a declaration of general policy of the cabinet, the premier must resign.

Health and Welfare. Health insurance partially covers medical, pharmaceutical, and hospitalization costs in most cases, and the complete cost of such services for low-income groups, the unemployed, and children under ten years of age. Health and all other social insurance is under the jurisdiction of the Social Security Administration. Social insurance includes family allowances, workmen's compensation, maternity benefits, and disability and old-age insurance. Approximately 98 percent of the total population of France is covered by the compulsory plan.

Legislature. Supreme legislative authority is vested in the National Assembly. The Senate is an advisory body with the right to examine and render opinions on legislation and policies initiated in the National Assembly and to delay, but not prevent, the passage of legislation. If the two chambers disagree on a bill, final decision rests with the National Assembly, which may either accept the version of the Senate or, after a specified period, readopt its own version. Acting in an advisory capacity on economic matters to the National Assembly and the Council of Ministers is the Economic and Social Council, consisting of representatives from groups of workers and of employers, and from professional and cultural organizations. The Constitution of 1958 limits the National Assembly to two regular sessions annually totaling five-and-one-half months, permits the adoption of votes of censure against the government by an absolute majority only (instead of a majority of those voting, as previously), and forbids sponsors of an unadopted motion of censure to introduce another such motion during the same session. Constitutional amendments may be adopted after approval by both chambers of parliament and by a subsequent popular referendum, or merely by approval of three fifths of the total membership of the chambers. However, for the procedure followed in adoption of a constitutional amendment in 1962, see *History*, below.

Political Parties. France has often had numerous political groups, many of which differ from one another on only minor points of theory or policy. The legislative requirements of the Fifth Republic, however, have tended to force the merger or coalition of independent political parties. Four major groups—two centrist organizations and two leftist parties—emerged from the parliamentary elections of early 1978. The moderate groups were the *Rassemblement pour*

la République (*Rally for the Republic*), founded in 1976 by former Premier Jacques Chirac (1932–) and claiming affinity with the ideas of former President Charles de Gaulle (qv), and the *Union of French Democrats*, a coalition built around the Republican Party and closely tied to President Valéry Giscard d'Estaing (qv). The leftist parties were the Socialist Party, led by François Mitterrand (1976–), and the French Communist Party, headed by Georges Marchais (1920–).

Local Government. For local administrative purposes, the departments of France are divided into communes, which are governed by municipal councils of between ten and thirty-six members, who are elected for six-year terms. Each council elects, from its membership, a mayor, who represents the national government. Metropolitan France has about 38,000 communes. The communes, differing greatly in area and population, are often identical with municipalities. Other units of local government are the *arrondissement* and the *canton*.

Judiciary. Justice is administered in France in petty criminal and civil cases by local courts called *Tribunaux of Instance* and *Tribunaux of Great Instance*. Crimes punishable by prison terms of five years or less and major civil cases are tried in correctional courts. Appeals from all of these lower courts are heard by courts of appeal. Major criminal cases are tried before the courts of assizes. Appeals from decisions of the courts of assizes and the courts of appeal may be reviewed by the court of cassation, which may annul judgments and order new trials.

Defense. Military service is compulsory for sixteen months for males between the ages of twenty and thirty-seven. Defense expenditures in the mid-1970's totaled about \$13 billion annually. In the mid-1970's the army numbered about 338,500, the navy about 68,600, and the air force about 101,000. Although France remained a member of the council of the North Atlantic Treaty Organization (qv), French military forces were withdrawn from the NATO command in October, 1966. France has been developing a nuclear force, including nuclear submarines and ballistic missiles.

HISTORY

The names of French rulers, most of whom are the subjects of separate articles, and the dates of their reigns are in the accompanying table. The numerous cross references in the following account direct the reader to related articles. The reader is also directed to separate articles on many other Frenchmen whose birth and death dates are not given. See also *EUROPE History*.

RULERS OF FRANCE

Carolingian Dynasty

Pepin the Short	751-68
Charlemagne	768-814
Louis I the Pious	814-40
Charles I the Bald	840-77
Louis II	877-79
Louis III	879-82
Carloman	879-84
Charles II the Fat	884-87
Eudes, Count of Paris	888-98
Charles III the Simple	893-923
Robert I	922-23
Rudolph (or Raoul), Duke of Burgundy	923-36
Louis IV	936-54
Lothair	954-86
Louis V	986-87

Capetian Dynasty

Hugh Capet	987-96
Robert II	996-1031
Henry I	1031-60
Philip I	1060-1108
Louis VI	1108-37
Louis VII	1137-80
Philip II, or Philip Augustus	1180-1223
Louis VIII	1223-26
Louis IX (Saint Louis)	1226-70
Philip III	1270-85
Philip IV	1285-1314
Louis X	1314-16
John I	1316
Philip V	1316-22
Charles IV	1322-28

Valois Dynasty

Philip VI	1328-50
John II	1350-64
Charles V	1364-80
Charles VI	1380-1422
Charles VII	1422-61
Louis XI	1461-83
Charles VIII	1483-98
Louis XII	1498-1515
Francis I	1515-47
Henry II	1547-59
Francis II	1559-60
Charles IX	1560-74
Henry III	1574-89

Bourbon Dynasty

Henry IV	1589-1610
Louis XIII	1610-43
Louis XIV	1643-1715
Louis XV	1715-74
Louis XVI (beheaded 1793)*	1774-92
Louis XVII (nominal ruler only)	1793-95

The Republic

National Convention	1792-95
The Directory	1795-99

The Consulate
1799-1804

First Empire

Napoleon I, Emperor of France	1804-15
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The Restoration

Louis XVIII	1814-24
Charles X	1824-30
Louis Philippe	1830-48

The Second Republic

Louis Napoleon, President	1848-52
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The Second Empire

Napoleon III (Louis Napoleon), Emperor	1852-70
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The Third Republic

General Louis Jules Trochu, President, Government of National Defense	1870-71
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ELECTED PRESIDENTS

Louis Adolphe Thiers	1871-73
Comte Marie Edmé Patrice Maurice de MacMahon	1873-79
François Paul Jules Grévy	1879-87
Marie François Sadi Carnot	1887-94
Jean Paul Pierre Casimir-Périer	1894-95
François Félix Faure	1895-99
Émile Loubet	1899-1906
Clément Armand Fallières	1906-13
Raymond Poincaré	1913-20
Paul Deschanel	1920
Alexandre Millerand	1920-24
Gaston Doumergue	1924-31
Paul Doumer	1931-32
Albert Lebrun	1932-40

Vichy Government

Henn Philippe Pétain, Chief of State	1940-44
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Provisional Government

Charles de Gaulle, Head of State	1944-46
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Fourth Republic

Georges Bidault, Provisional President	1946
Vincent Auriol	1947-53
René Coty	1953-58

Fifth Republic

Charles de Gaulle	1958-69
Georges Pompidou	1969-74
Valéry Giscard d'Estaing	1974-

Early History. The region constituting contemporary France appears in recorded history for the first time with the establishment, about 600 B.C., of Massilia, now Marseille. This colony was founded by the Phoenicians (see PHOENICIA), who named the natives of the surrounding territory *Keltoi* (Gr. "Celts"). Probably by extension, the term was eventually applied to all of the dominant tribes in the area bounded by the Atlantic, the Rhine R., the Alps, and the Mediterranean (see CELTIC PEOPLES AND LANGUAGES). The Celtic-speaking peoples of western Europe called their domain *Gaeltachd* ("the land of the Gauls"), from which the Roman name for the region was derived; see GAUL. In the early stages of the Roman Republic, invaders from Gaul occupied the northern portion of what is now Italy. The Gauls in this region, known in Rome as *Gallia Cisalpina* ("Gaul this side of the Alps"), and other Celtic-speaking tribes of Gaul fought periodically with the Romans for centuries. After 51 B.C., when the Roman general and statesman Gaius Julius Caesar (q.v.) won an eight-year war of conquest in Gaul, the entire territory became a province of Rome. The Emperor Augustus (q.v.) divided Gaul into four provinces in 27 B.C. The Gallic peoples rapidly assimilated the culture of their conquerors, and

* Louis XVI was deposed (Aug. 10, 1792) during the French Revolution. The monarchy was supplanted by the First Republic on Sept. 20, 1792. From that date until Oct. 26, 1795, the National Convention and its chief organ, the Committee of Public Safety, governed France. The Directory superseded the National Convention on Oct. 27, 1795, and remained in power until Nov. 9, 1799. Between the downfall of the Directory and the establishment of the First Empire, France was ruled by the Consulate.

Gaul soon became a principal Roman dominion, especially important in the imperial defense system against the Teutonic tribes to the north and east.

With the disintegration of Roman power in the 4th and 5th centuries A.D., the Teutonic tribes, under pressure from the marauding Huns (q.v.), occupied large sections of the Roman dominions, including Gaul. The Visigoths (see GOTHs) occupied by stages almost the entire regions of the Loire R. and w. of the Rhône valley. The Burgundians (see BURGUNDY) seized the territory between that of the Visigoths and the Alps. Most of Gaul to the n. of these areas fell to the Franks (q.v.). Other Germanic tribes, chiefly the Angles, Saxons (qq.v.), and Jutes (see JUTLAND), invaded Britain during the same period. Unable to expel the barbarians, the hard-pressed Romans accepted them as allies against their common foe, the Huns. In 451 a combined army of Romans and Teutons, chiefly Visigoths, defeated the forces of the Hunnish king Attila (q.v.) near Châlons-sur-Marne, ending the threat of Hunnish dominance in Europe. The Western Roman Empire lasted for only twenty-five years after this victory, however. In 476 Odoacer, King of the Teutonic Heruli (434?–93), organized a rebellion against imperial authority, deposing the puppet ruler Romulus Augustulus, last Roman Emperor of the West (b. 461).

The Merovingians. In 486 Clovis I, a pagan chieftain of the Salian division of the Franks and the greatest of the Merovingian (q.v.) dynasty of Frankish kings, defeated Syagrius (430?–486), last governor of the shrunken Roman dominions in Gaul. In 496 Clovis became a convert to Christianity and gained the invaluable support of the Church in his subsequent efforts to conquer all of Gaul. Clovis added substantially to his domain during the next decade, winning control of Burgundy in 500 and driving the Visigoths into the Iberian peninsula in 507. Following the death of Clovis in 511, his realm was apportioned among his four sons. After a period of conflict, only Clotaire (d. 561) survived his three brothers, and for a short time, from 558 to 561, the Frankish realms were again united. Clotaire's division of his land among his four sons resulted in further conflict, from which emerged the kingdoms of Austrasia in the east and Neustria in the west. Burgundy, with no king of its own, joined Neustria. Although the kingdoms were again consolidated for a time under Clotaire II, the Frankish realm was torn by strife, and the authority of the Merovingian monarchs diminished. Parallel with this process, the leading court official, the Mayor of the Palace, ac-

quired greater power, and the nobles became increasingly independent, accelerating the development of feudalism (q.v.). The Dark, or early Middle, Ages that had enveloped most of Europe following the collapse of the Western Roman Empire was most pronounced in the Frankish realm under the Merovingians. As political chaos mounted, intellectual stagnation deepened. Scholarly pursuits were confined to certain monastic organizations of the Church. The Greek and Roman heritage of learning was otherwise forgotten. One cultural development of lasting significance gradually evolved, however. The western Franks slowly assimilated the Latinized Gallic tongue, and the eastern Franks retained their native Teutonic speech, creating linguistic differences that eventually led to a permanent cleavage of the Frankish domain and laid the bases of modern France and Germany.

The kings of Austrasia were completely dominated by Pepin of Herstal, Mayor of the Palace (see under PEPIN), from about 687 until his death in 714. He was succeeded by his son Charles Martel (q.v.), who won control of Neustria and Burgundy, thereby reestablishing Frankish unity. In 719, Muslim invaders, who had previously seized control of the Iberian peninsula, began to occupy the southern portion of the Frankish realm (see MOORS; SPAIN: *History*). In 732, with the help of the Lombards (q.v.), Charles Martel decisively defeated the Muslim forces at a site between Tours and Poitiers (qq.v.), thus saving feudal western Christendom from Muslim domination.

The Carolingians. On the death of Charles Martel in 741, the post of Mayor of the Palace (of both Austrasia and Neustria) was inherited by his son Pepin the Short. Pepin ruled in this capacity until 751, when he deposed Childeric III (d. 751?) and, with the blessings of Pope Zacharias, assumed the royal title. Thus began the Carolingian (q.v.) dynasty of Frankish kings, whose combined reigns lasted nearly 250 years. In 754, in appreciation of the friendly attitude of the papacy, Pepin attacked the Lombards, then threatening the incumbent Pope, seized part of their territory, and bestowed it upon the Church. His reign was marked by additional military successes, including the conquest of Aquitaine, the region to the south of Neustria, and victories over various frontier tribes as well as over the Moors of Spain.

Pepin the Short laid the foundations of the Frankish Empire, the first important state, excluding the Byzantine Empire, to develop on the European continent after the collapse of the Roman Empire. Although the Frankish Empire



A painting of the Battle of Tours (732), near Poitiers in which Charles Martel defeated the Muslim invaders
Giraudon

had only a brief history, limited in effect to the reign of Pepin's son Charlemagne, its appearance signaled the opening of a new stage in the political, intellectual, and religious processes in Europe.

CHARLEMAGNE Charlemagne vastly extended the boundaries of his kingdom, successively subjugating the Saxons, Lombards, and various tribes of central Europe. By the introduction of several administrative innovations, notably the establishment of counties, a federal officialdom responsible to the crown, and an advisory body of leading nobles, he centralized authority and curbed the powers of the feudal lords. Of equal importance, he sponsored a revival of intellectual activity, founding numerous schools and patronizing men of learning. Generally, if not substantially, he raised the level of Western civilization. Charlemagne rendered outstanding services to the Church. He forced the pagan tribes he conquered to espouse Christianity, imposed taxes for the benefit of the Church, waged war against the Muslims, and founded many places of worship. In recognition of these and other services, in 800 Pope Leo III (see *under* LEO) crowned him Emperor of the West.

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This move, essentially an attempt to resuscitate the vanished glory of the Caesars and the secular power of the papacy, introduced the concept of the later Holy Roman Empire (q.v.).

DECLINE OF THE CAROLINGIAN EMPIRE In the century following the death of Charlemagne in 814, the Frankish Empire disintegrated into a multitude of warring kingdoms, duchies, and minor fiefs. The disintegration, begun during the reign of Charlemagne's son and successor Louis I, resulted from various factors, including the emperor's ineptitude as a ruler, rivalry among his sons for political power, depressed economic conditions, and the burgeoning feudal system. Before the emperor's death in 840, his sons, unable to agree on how to divide the empire, began a costly struggle, which was terminated three years later by the Treaty of Verdun (see VERDUN, TREATY OF), under the terms of which Charles I, later Holy Roman emperor as Charles II (q.v.), received the western portion of the empire, Louis II the eastern portion, and Lothair I the region between these states; Lothair received the imperial title. In political geography, the first and second of these new states roughly approximated respectively modern France and Germany. The intermediate kingdom, composed substantially of Lotharingia (see LORRAINE), Provence (q.v.), Burgundy, and Lom-

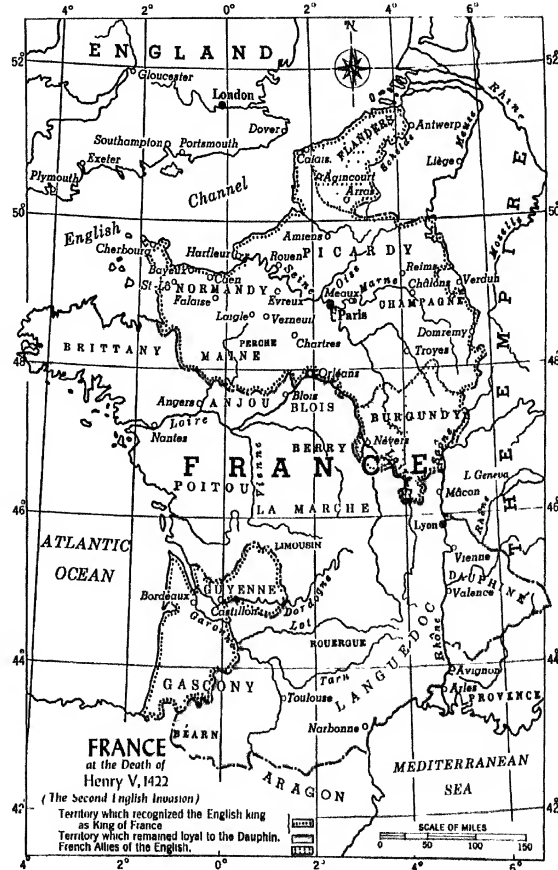
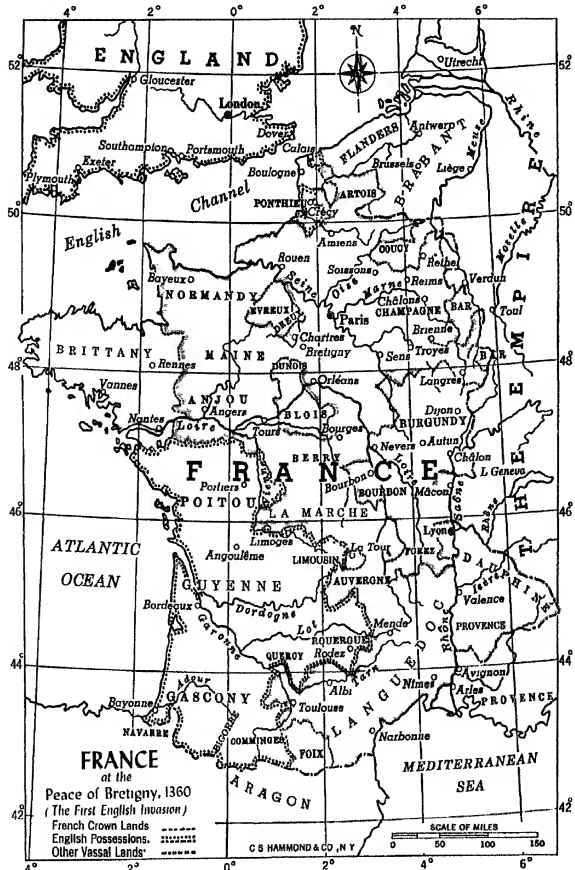
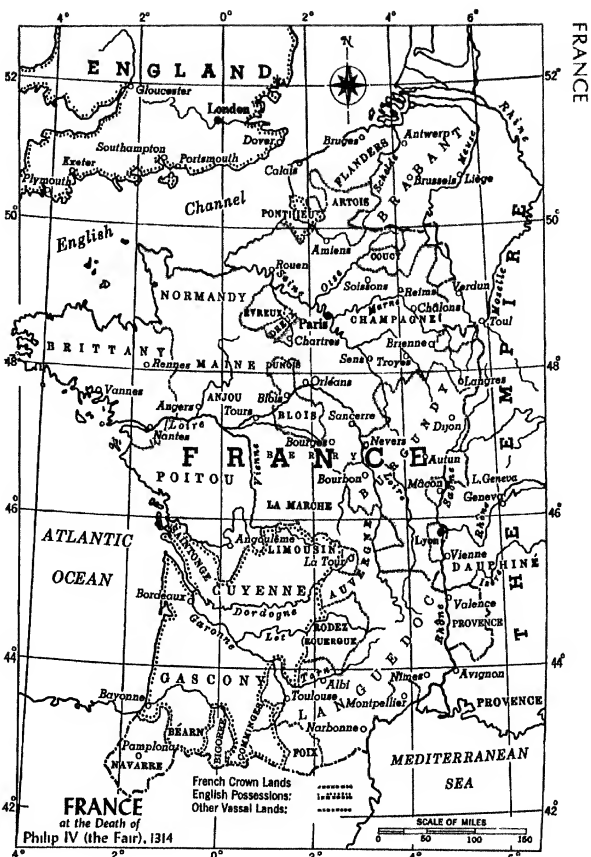
bardly, soon became, by virtue of the Salic Law (q.v.), as well as internecine strife and external conquest, a multiplicity of shifting dependencies and principalities. For many centuries, parts of the kingdom caused friction and conflict between the new national groupings.

Under Charles I the West Frankish kingdom was steadily weakened by wars. The king became increasingly dependent on the military support of the feudal lords, one of whom, Robert the Strong (d. 866), was granted the dukedom of France, which later gave its name to the entire country. The Norsemen (q.v.) launched raids on Charles' dominions, on one occasion (845) capturing Paris. Charles II, King of France, and as Charles III, Holy Roman Emperor, reunited the eastern and western divisions of the former Frankish Empire in 884. Three years later, as the result of a humbling treaty which he had concluded with the Norsemen in 886, he was forced to abdicate. With his abdication, the cleavage between the eastern and western Franks became permanent. Political turmoil continued in the West Frankish kingdom for a protracted period after the deposition of Charles. The Norsemen multiplied their attacks on the coastal region, and Charles III, King of France, purchased immunity from further encroachments by ceding to them, in 911, the region later known as Normandy (q.v.). By degrees the feudal lords usurped more and more of the remaining authority of the crown. But the Carolingian dynasty persisted until 987, when a coalition of dominant nobles, rejecting the hereditary claimant to the throne, bestowed the crown on Hugh Capet, Duke of France, who thereby became the founder of the Capetian (see CAPET) dynasty of French kings.

The Capetian Dynasty. Like that of his immediate predecessors, the authority of Hugh Capet extended little beyond Paris and Orléans. The heads of the surrounding feudal domains, including Aquitaine (see AQUITANIA), Burgundy, Normandy, and Flanders (qq.v.), wielded considerably more power than any of the three rulers who succeeded Capet. In 1066, however, William, Duke of Normandy, later William I (q.v.), King of England, conquered England, appreciably reducing the immediacy of the threat, implicit in Norman strength, to the Capetians (see ENGLAND; *History*). The royal power was further strengthened in 1096 when many of the feudal lords of France embarked on the First Crusade, which brought death and economic ruin to many of its leaders (see CRUSADES). The first king significantly to challenge feudal power within the Capetian domain was Louis VI, who

ascended the throne in 1108. His vassals, subdued after more than twenty years of armed struggle, finally recognized the royal authority. Thus strengthened, the kingdom repelled an invasion led by Henry V (q.v.), Holy Roman Emperor. The next member of the Capetian dynasty, Louis VII, conquered Champagne and, through marriage, added Aquitaine to his dominions, but he lost the last-named region in 1152 as a result of the dissolution of his marriage. Aquitaine shortly passed, again through marriage, to Henry, Duke of Anjou, who in 1154 became Henry II (q.v.), King of England. In an ensuing war with England, Louis failed to break Henry's hold on French territory. Philip II, who succeeded Louis in 1180, resumed the war on England and finally won control of Normandy, Anjou, and most of the other English possessions in France except Gascony (qq.v.). Philip instituted important governmental reforms, particularly in the administration of justice. These reforms, one of which established the right of appeal to the royal courts, curbed the arbitrary powers of the feudal nobility. Philip also divided his dominion into smaller political units known as communes, established a national standing army, and strengthened the royal treasury. By these and other accomplishments, including the defeat at Bouvines in 1214 of the anti-Capetian alliance of Otto IV, Holy Roman Emperor (see *under* OTTO), John (q.v.), King of England, and the count of Flanders, Philip transformed France into a leading European power. Also during his reign was the Albigensian-Waldensian Crusade; see ALBIGENSES; WALDENSES. The consolidation of the kingdom continued during the reigns of Philip's son Louis VIII and grandson Louis IX. Louis IX (canonized in 1297 as Saint Louis) achieved a reputation as the most chivalrous and just monarch of his time. During his reign, termed the golden age of medieval France, the French monarchy was consolidated and the power of the feudal lords and churchmen decreased; national administration was improved and reformed; and the problem of English possessions in France was peacefully adjusted by the Treaty of Paris in 1259, whereby Henry III (q.v.), King of England, was recognized as feudal lord of Gascony and Guienne, but relinquished all claims to Normandy, Anjou, Touraine, and Maine.

Following the reign of Louis' son Philip III, a generally inept sovereign, the borders of France were further extended at the expense of neighboring fiefs, and the drive of the French monarchs to secure absolute control of the state was intensified. In a move designed to subordinate





The founder of the Capetian dynasty of French kings, Hugh Capet, at his coronation in 987.

Bettmann Archive

ecclesiastical power to royal authority and, at the same time, strengthen the royal treasury, Philip IV imposed a tax on the clergy. The move precipitated a bitter controversy with Pope Boniface VIII (see *under* BONIFACE), during which Philip established the first States General (parliament) by summoning not only the nobles and clergy but also representatives of the burgher class, or third estate. With the election in 1305 of Clement V (see *under* CLEMENT) as pope, the struggle was resolved in favor of Philip, who thenceforth had the support of the papacy in his campaign to strengthen the kingdom; see SCHISM, WESTERN OR GREAT. The powerful religious and military order of Knights Templars (q.v.) was destroyed in France with Clement's help.

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Philip substantially increased the authority of the crown; additions to his domain included Franche-Comté and several other fiefs in the east.

The death, without male issue, of Philip's three sons Louis X, Philip V, and Charles IV ended the Capetian dynasty of French kings in 1328.

The Valois Dynasty. The throne passed to Philip VI, a nephew of Philip IV and founder of the House of Valois. Anglo-French antagonisms, stemming chiefly from rivalry for control of economically important Flanders and Guienne and from French support to the independence movement in Scotland, were intensified during the reign of Philip VI. These antagonisms, aggra-

vated by the contention of Edward III (q.v.), King of England, that the French throne rightfully belonged to him, erupted into armed conflict in 1337. In the initial stage of the conflict, known as The Hundred Years' War (q.v.), the English inflicted a number of disastrous defeats on France, especially at Crécy; see CRÉCY, BATTLE OF. Calais fell to the English in 1347, one year after this victory, enormously improving their strategic position. Arbitrary conscription, debased currency, and onerous taxation brought the nation to the verge of ruin. In 1356 John II, King of France, was defeated at Poitiers and taken prisoner. This debacle precipitated the first revolutionary crisis of the French state. Under the leadership of Étienne Marcel (d. 1358), a States-General faction consisting of burghers and nobles seized control of the government in February, 1357. The revolution was attended by considerable violence, including an abortive peasant insurrection, called the Jacquerie (q.v.). As a result of defections among Marcel's allies, the royalists of France regained power and on July 31, 1358, Marcel was executed. By the Peace of Brétigny in 1360, King John obtained his freedom and cessation of hostilities with England at the cost of a huge ransom and the annexation of a third of his domain by Edward III; see BRÉTIGNY, PEACE OF. The war was resumed during the reign of Charles V, under his great military leader, Bertrand Du Guesclin, who from 1369 to 1375 succeeded in reducing the English holdings in France to Bordeaux, Cherbourg, Calais, Bayonne, and Brest. Following the mental collapse of Charles VI in 1392, the rivalries between the houses of Burgundy and Orléans for control of the regency led to a protracted civil war. Henry V (q.v.), King of England, taking advantage of this internal strife, virtually annihilated the French army at Agincourt (see AGINCOURT, BATTLE OF) in 1415. In alliance with Burgundy, England quickly gained possession of all of France northeast of the Loire R. The war against England was renewed by Charles VII. A succession of victories, largely inspired by the leadership and patriotism of Joan of Arc, culminated in 1453 in the expulsion of the English from all of their French possessions except Calais. The war was not officially terminated, however, until the signing of the Treaty of Étaples on Nov. 3, 1492.

France emerged from the Hundred Years' War with a badly damaged economy. In addition, sections of the country were at the mercy of mercenaries and marauders, and feudal power again challenged the crown's authority, particularly in Burgundy. Before he died in 1461,



Joan of Arc, saint and national heroine of France, a detail from a painting by the 19th-century French artist Jean Auguste Dominique Ingres. French Cultural Services

Charles VII had instituted a permanent system of taxation and, with the support of the important Third Estate of the powerful States-General, introduced various other reforms designed to unify the country. His successor, Louis XI, finished the task of unification by routing the feudal barons, principally the Duke of Burgundy, and establishing firm foundations for royal absolutism by breaking the power of the States-General. Brittany was added to the kingdom during the reign (1483–98) of Charles VIII by his marriage to Anne of Brittany. In 1495 Charles attacked Naples, beginning a long period of similar imperialistic adventures by the kings of France. Louis XII, undeterred by the failure of Charles' Italian campaign, waged successive wars against Milan, Naples, and Venice, but achieved no permanent conquests. The unsuccessful outcome of his military adventures was largely the result of the formation against France of a coalition of states which was known as the Holy League. With the establishment of this alliance, Continental statesmen introduced the system of power politics and balance-of-power principle which thereafter dominated in-

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ternational relations in Europe. Louis XII promulgated numerous fiscal and judicial reforms during his reign, further increasing the prestige of the monarchy. Francis I, his successor, adhered to his aggressive foreign policy. Following Francis' victory in 1515 over Milan, and a concordat concluded in 1516 with Pope Leo X, he sought election as Holy Roman emperor. The imperial title was won, however, by the Spanish king Charles I, who became Charles V (q.v.), Holy Roman Emperor, and whom Francis shortly engaged in a series of devastating wars which lasted over forty years. As a consequence, France lost Milan in 1529. The diplomacy of Francis' regime was conditioned largely by the religious rebellion then developing throughout western Europe against the papacy (see REFORMATION).

Francis maintained friendly relations with Henry VIII, King of England, and the Lutherans of Germany, despite the concordat with the pope, but he suppressed Calvinism in France. Supported by the French bourgeoisie and clergy, the king completed the centralization of royal authority at the expense of the remaining feudatory barons. The monarch's chief contributions to the national development of his country were cultural and intellectual. With his encouragement the Renaissance (q.v.), already flourishing in the Italian states, took root in France.

The century following the accession in 1547 of Henry II to the French throne was a period of sanguinary factional strife. Religious intolerance, marked by savage persecution of the Huguenots (q.v.), as the French Protestants were known, gained substantial headway under Henry's despotic regime. Henry seized the bishoprics of Metz, Verdun, and Toul from the Holy Roman Empire in 1551 and expelled the English from Calais seven years later. During the final years of his reign, which ended in 1559, he suffered serious reverses, including the loss of his Italian holdings. France was torn by recurring civil wars for more than thirty years after Henry's death.

Religious antagonisms were a central factor in these conflicts, with the contending factions manipulated for political ends by rival groups of the French nobility. Between the two factions, and playing one against the other, was the unscrupulous Catherine de Médicis, Henry's wife and queen mother of the three inept rulers who followed him on the throne. Led by such figures as Gaspard de Coligny and Henry of Navarre, later king as Henry IV, the Huguenots gradually strengthened their position, finally obtaining

control, in 1570, of four strategic French cities. The peace that followed this victory endured for little more than two years. In 1572, fearful of growing Protestant power, Catherine planned, with the support of her son Charles IX and the Roman Catholic faction, a treacherous attack on the Huguenots. The order for the attack was given on Aug. 24, and thousands of Protestants were massacred throughout France (see SAINT BARTHOLOMEW'S DAY, MASSACRE OF). French religious and political rivalries intensified during the reign of Henry III (q.v.), bringing on a resumption of civil warfare in 1574. Chiefly because of an agreement between Philip II, King of Spain, and Charles de Lorraine, a member of the powerful Guise (q.v.) family and leader of the Roman Catholic faction in France, by the terms of which Charles would succeed to the throne, Henry espoused the Protestant cause. The king's troops suffered a series of defeats, climaxed by a successful Catholic rebellion in Paris. By the summer of 1588, Henri I de Lorraine, 3rd Duc de Guise controlled most of France. The subsequent destruction of Philip's Armada (q.v.) by the English navy encouraged Henry to strike back at his chief enemies. In December, 1588, he organized the assassination of Henri I de Lorraine and his brother Cardinal Louis II de Lorraine (1555-88). Henry's death occurred, also by assassination, in the next year, and the crown of France passed to Henry of Navarre, a descendant of Louis IX.

The Bourbon Dynasty. With Henry of Navarre, or Henry IV, began Bourbon (q.v.) rule, which lasted for 206 years.

HENRY IV. The new ruler immediately resumed the war against the French Catholics, who received effective aid from Spain. Through his renunciation of Protestantism in 1593, however, Henry rallied most of the adherents of the Catholic party to the royal banner. He entered Paris in the next year, concluded the war with the Holy League in 1596, and caused the Spanish king to sue for peace in 1598. In April, 1598, he issued the Edict of Nantes (q.v.), which guaranteed religious freedom in France. Establishing the pattern perpetuated by the later Bourbons, of extreme concentration of governmental authority in the crown, Henry quickly restored order to his war-torn kingdom. He gave special attention to economic rehabilitation, encouraging expansion in the fields of agriculture, industry, and commerce; vastly increased the royal revenues; and sponsored colonization projects in Canada.

LOUIS XIII AND RICHELIEU. In the century following the accession in 1610 of the infant Louis XIII,

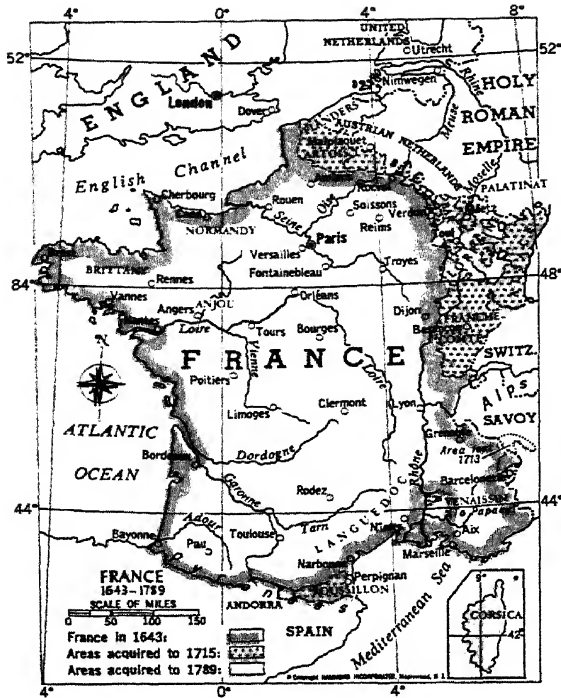
France became the most powerful nation in Europe. The central figure in the initial phase of the drive to imperial greatness was the statesman and cardinal Duc de Richelieu, whose rise to power began during the regency of the king's mother, Marie de Médicis. Appointed chief minister to the king in 1624, Richelieu seized the opportunity, provided by generally unsettled conditions resulting from Marie's mismanagement of the realm, to eliminate all political opposition and dispense with all pretense of representative government. The States-General, in adjournment since 1614, was ignored, and a policy of rule by royal decree was instituted. Between 1622 and 1628, Richelieu crushed a rebellion of the Huguenots, who were deprived of

their privileged position in French political life. He also destroyed political opposition among the nobility, established strict internal-security controls, including a system of espionage, and created a powerful army. In foreign affairs, Richelieu developed a policy of imperial aggrandizement, directed primarily at weakening the Hapsburgs (q.v.). The outbreak of the Thirty Years' War (q.v.) in 1618 provided the opportunity. Despite his exalted position in the Roman Catholic Church and the Catholic faith of a majority of the French people, Richelieu began, in 1630, to subsidize the war effort of Gustavus II (q.v.), King of Sweden against the Holy Roman Empire. In 1635 Richelieu organized an alliance with Sweden and other Protes-

Cardinal Richelieu, the powerful statesman of France during the 17th century, in a portrait by the Flemish artist Philippe de Champaigne.
Giraudon



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tant groups of northern Europe and intervened directly in the conflict. Both the Holy Roman Empire and Spain weakened steadily under the blows of the coalition, which was maintained, after Richelieu's death in 1642, by the new prime minister of France, Cardinal Jules Mazarin.

MAZARIN AND THE REGENCY OF LOUIS XIV. Ferdinand III (q.v.), Holy Roman Emperor, capitulated in 1648, signing the Peace of Westphalia (see WESTPHALIA, PEACE OF). By the terms of this document France acquired indisputable title to the bishoprics of Verdun, Metz, and Toul, obtained most of Alsace, and imposed provisions that postponed for more than 200 years the formation of a unified German state. The Franco-Swedish victory over Ferdinand insured French hegemony on the continental mainland.

As a result of the financial drain of the Thirty Years' War, a strong opposition movement, known as the Fronde, developed in 1648 against the Mazarin administration. The Fronde, led by refractory nobles and representatives of all sections of the population, was eventually defeated by Mazarin in 1653. By crushing the Fronde, Mazarin erased the remnants of French feudalism and laid the basis for the despotism of the last of the Bourbons. Spain, hopeful of victory because of the internal turmoil in France, had meanwhile continued the war begun in 1635. Largely by means of superior diplomacy, especially an anti-Spanish agreement with the Lord

Protector of England, Oliver Cromwell, Mazarin brought the military stalemate to a victorious conclusion in 1659, further strengthening France and weakening Spain (see PYRENEES, PEACE OF THE). **PERSONAL REIGN OF LOUIS XIV.** The French kingdom reached the zenith of military power and cultural achievement during the period, following the death of Mazarin in 1661, when Louis XIV exercised personal control of the government. With the guidance of his finance minister Jean Baptiste Colbert, Louis perfected the administrative apparatus of the state, constructed a strong navy, encouraged the development of industry and foreign commerce, and entered the imperialist race for colonies. Large territories in North America, India, the West Indies, and other regions of the world were added to the royal dominions. Under the direction of such military experts as Sébastien Le Prestre, Marquis de Vauban (1633–1707) and Henri de la Tour d'Auvergne, Vicomte de Turenne, the French army became the strongest in Europe. In 1682 Louis formally opened his great palace, Versailles (q.v.), and installed his court, both of which served as models for princes and kings throughout Europe. French society attained an unparalleled level of culture and refinement. Louis's reign was the golden age of French literature, dominated by Pierre Corneille, Jean Baptiste Racine, Molière, François de La Rochefoucauld, and Jean de La Fontaine. In 1667 Louis XIV embarked on a series of wars, with the ultimate objective of maintaining French domination of Europe. The first of these wars, which were aimed primarily at the Spanish and German Hapsburgs, sought control of the Spanish Netherlands, Franche-Comté, and Luxemburg. Known as the War of the Devolution (see DEVOLUTION, WAR OF THE), it was halted by Louis when, in 1668, England, Sweden, and Holland, fearful of French ambitions, completed an alliance which gave them the balance of power in Europe. After breaking the alliance by bribing Charles II, King of England (q.v.), and by similar diplomacy toward Sweden, Louis attacked Holland in 1672. A new alliance, composed of the Holy Roman Empire, Spain, and several German states, intervened in this conflict, but the French military machine, despite serious setbacks, was generally successful. Under the provisions of the Nijmegen treaties which ended the war of 1678, France obtained Franche-Comté and various positions in the Spanish Netherlands. In 1685, during the ensuing interval of peace, Louis revoked the Edict of Nantes. The revocation forced thousands of Huguenots, as a group the most industrious citizens of France, to flee the



"Louis XIV and his Heirs", a painting by his contemporary, the French court artist Nicolas de Largillière

Wallace Collection, London

country; see CAMISARDS. Louis' next military adventure, directed again at the Spanish Netherlands and at some of the German principalities between the eastern borders of France and the Rhine R., lasted from 1688 to 1697. Resisted by a major coalition of powers called the League of Augsburg, which was joined by England following the Glorious Revolution, France was finally forced to sue for a peace treaty (see GRAND ALLIANCE; KING WILLIAM'S WAR). The naval phase of the struggle was climaxed by an English-Dutch victory in 1692 off La Hogue that crippled the sea power of France.

Under the terms of the Peace of Ryswick (see RYSWICK, PEACE OF), which in 1697 closed the nine years of war, France lost control of Lorraine and its holdings in Catalonia and the Spanish Netherlands. Louis was allowed to retain Alsace, and Pondicherry (q.v.), which had fallen to the Dutch, was returned to him.

The French monarch's final bid for Continental hegemony, which he planned to secure by placing a Bourbon on the Spanish throne, met determined resistance by a coalition of European powers, led by England, which favored a Hapsburg. Although Charles II, King of Spain (see under CHARLES), who was without heirs, willed his crown to Louis' grandson Philip, the

friction between France and the coalition flared up in 1701, after the death of Charles, into what is known in history as the War of the Spanish Succession; see SPANISH SUCCESSION, WAR OF THE; QUEEN ANNE'S WAR. The allied nations inflicted a series of severe defeats on the French, particularly at Blenheim (see BLENHEIM, BATTLE OF), at Audenarde, and later at Malplaquet; but divisions among the victorious powers finally saved France from utter catastrophe. The fighting ended in 1713; see UTRECHT, PEACE OF. Nonetheless, France emerged from the war a second-rate power, heavily in debt, burdened with oppressive taxes, and minus part of its territory. Philip was allowed to retain the throne of Spain, but his realm was deprived of Gibraltar and Minorca, which were granted to England, and of other possessions. Louis survived the humiliation of Utrecht by less than two years. His death in 1715 closed the longest reign in the history of Europe.

LOUIS XV. The stability of the French throne, already shaken to its foundations, was further disturbed during the regency that administered the nation during the minority of Louis XV. In an ef-

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fort to stave off impending national bankruptcy, the leaders of France placed John Law (q.v.), a Scottish adventurer and financier, in supreme control of royal fiscal and colonial policy. Law's fantastic schemes, chiefly the issuance of unsecured paper currency and the development of the North American colony of Louisiana by means of that currency, collapsed in 1720, aggravating the domestic economic crisis. Conditions were subsequently improved somewhat by Louis' chief counselor, André Hercule Cardinal de Fleury (1653–1743). Despite Fleury's pacific foreign policy, however, France became involved in the wars of the Polish and of the Austrian Succession; see SUCCESSION WARS; KING GEORGE'S WAR. From the first of these conflicts, from 1733 to 1735, France secured Lorraine for Louis' father-in-law, Stanislas I Lexzcyński (q.v.), King of Poland, and regained, to a large degree, its lost prestige. The second war, from 1740 to 1748, weakened the position of the kingdom, both economically and diplomatically. After Louis' assumption of personal control of the French government in 1743, the internal crisis deepened steadily. The king, completely dominated by one of his mistresses, the Marquise de Pompadour (q.v.), earned the contempt and hatred of the French people, as much by his immorality and the corruption prevalent in his court as by his mismanagement of the realm. Because of faulty diplomacy, which brought France into alliance with its traditional enemy, Austria, and colonial rivalries with Great Britain, the kingdom was drawn into the Seven Years' War (q.v.), which precipitated, in North America, the French and Indian War (q.v.). These conflicts, from 1756 to 1763, caused incalculable losses to France, especially its Canadian territories, most of its possessions in India, and many units of its navy. Louis, however, added Lorraine to his realm in 1766, and Corsica was acquired two years later. In the closing years of his reign, Louis XV banished the Society of Jesus (see JESUITS), suppressed the Parlement of Paris, and raised taxes, increasing popular discontent. Class divisions in France widened, with the Encyclopedists, including Denis Diderot, Charles de Montesquieu, Jean Jacques Rousseau, Voltaire, and other intellectual leaders of the period, gaining prestige and influence among the artisans, lower clergy, petty bourgeoisie, and impoverished peasantry. The last-named social group bore the full brunt of taxation, surrendering, according to some estimates, no less than four fifths of the fruits of its toil in payment of various imposts. Want was the chronic condition of the working population, famine was a

common phenomenon, and mendicancy increased enormously. Toward the close of Louis XV's reign there were more than 1,000,000 beggars in France, which then had a population of about 23,000,000.

Louis XVI. Louis XVI, grandson and successor of Louis XV, made a few attempts to alleviate the misery of the impoverished people. For two years after ascending the throne in 1774, he entrusted the powerful post of comptroller general, with jurisdiction over finance, justice, and legislation, to Anne Robert Jacques Turgot, a liberal economist who instituted a more equitable distribution of taxation, abolished the *corvée*, and inaugurated other reforms. Turgot's program met violent opposition from Louis' queen, Marie Antoinette, and from the Roman Catholic hierarchy in France, the nobility, and the top strata of the bourgeoisie, who together forced his removal. The next comptroller general of France, Jacques Necker, favored a policy of direct aid to the American colonies, engaged, since 1775, in a revolutionary war against British rule (see AMERICAN REVOLUTION). He financed French support of the American cause by the floating of vast loans, which further undermined the national economy. Following 1781, when Necker was removed from office, a succession of ministers tried vainly to arrest the impending bankruptcy of the state. Scandal involving the royal family and certain prominent personages; see DIAMOND NECKLACE, THE AFFAIR OF THE, compounded the political difficulties of the regime. Public clamor for convocation of the States General, which had not met since 1614, finally developed, with the privileged classes determined to impose new taxes on the nation, and the Third Estate equally determined to initiate fundamental reforms.

Still hopeful of avoiding the onrushing catastrophe, Louis XVI, in 1788, recalled Necker as comptroller general and consented to States-General elections. Events thereafter moved swiftly toward a political collision between the contending social groups. On May 5, 1789, the States General, representing predominantly the Third Estate, convened at Versailles. Led by Emmanuel Joseph Sieyès and the Comte de Mirabeau, the Third-Estate caucus of the States General responded to royalist attempts to limit its effectiveness and objectives by proclaiming itself (June 17) a National Assembly. Three days later the members of the National Assembly, barred by royal decree from their meeting hall, assembled on one of the tennis courts at Versailles and solemnly swore, in what has since been known as the Tennis Court Oath, to re-

main in session until they had drafted a constitution for France. Alarmed at this display of determination and led by the isolation of the nobility and clergy from the Third Estate, Louis XVI shortly abandoned his intransigent stand, making possible the reconstitution of the States General. The Third Estate immediately renamed this body the National Constituent Assembly. Louis then ordered a mobilization of royalist troops. By this act and the subsequent dismissal of Necker, he provoked the population of Paris to open rebellion. The uprising, begun on July 14, 1789, with the storming and capture of the Bastille (q.v.), opened the initial phase of the French Revolution, one of the most cataclysmic social and political upheavals in the annals of mankind. With the collapse of the ancient regime, the promulgation of the Declaration of the Rights of Man and of the Citizen (q.v.), and the establishment of the First Republic, a new era began in France.

The First Republic. The revolutionary events and wars, together with the revolutionary ideals, embodied in the slogan "Liberty, Equality, and Fraternity", profoundly influenced the course of European history. The common peoples throughout central and southern Europe, inspired by the events in France, welcomed the victorious French armies and helped to establish democratic republics. Some of the deposed monarchs later regained their lost realms, but they finally proved incapable, in the face of recurring revolutionary outbursts, of containing the explosive social forces unleashed by the French people in the closing years of the 18th century. In the course of the 19th century, European absolutism was gradually eradicated. The new political epoch, a period of struggle for democracy, was attended, in particular in France, by political developments which frequently obscured for long intervals of time the historic objective of the peoples. For a detailed description of this period, see FRENCH REVOLUTION.

Sharp divisions among the various groups of the French revolutionary movement led to the collapse of the Directory (q.v.) and the First Republic in 1799. See also NATIONAL CONVENTION.

The Consulate. The overthrow of the Directory was accomplished, on Nov. 9, by a coup d'état organized by Sieyès, Lucien Bonaparte, and Napoléon Bonaparte, later Napoleon I, Emperor of France, who was one of the most brilliant and popular generals of the French Revolution. This junta, making political capital of the ineptitude and military failures of the Directory, proclaimed the formation of the new government, called the Consulate (q.v.), which vested

virtual dictatorial power in Napoléon Bonaparte. By 1798 he revealed, through his invasion of Egypt, the imperialist nature of his objectives. The major European powers, including Great Britain, the Holy Roman Empire, Russia, and Turkey, responded in 1799 to Bonaparte's Egyptian venture with a military alliance. In the spring of 1800 he moved against this coalition, beginning the sequence of conflicts known as the Napoleonic Wars (q.v.). The French armies ranged triumphant over most of central and southern Europe for nearly a decade.

The First Empire. At the height of his successes, Bonaparte decided to transform the Consulate into a hereditary empire. The plan, approved by a plebiscite of the French people, was effectuated with his coronation as emperor on Dec. 2, 1804, by Pope Pius VII (see *under* Pius), with whom Bonaparte, in 1801, had arranged a concordat that restored many of the privileges of the Roman Catholic Church. In March, 1804, the imperial government promulgated the Code Napoléon (q.v.), one of the chief by-products of the French Revolution and still the basis of the legal system of France and a number of the countries overrun by France during the Napoleonic Wars.

Although the British navy inflicted a serious defeat on Napoleon's naval forces in 1805 (see CAPE TRAFALGAR), ending his bid for naval supremacy, he became master, either by alliance or direct control, of nearly all of the continental mainland except Russia. In the countries which he subjugated, Napoleon outlawed feudal practices and introduced numerous democratic reforms. Restrictions were imposed on political liberty throughout the imperial domain, however. Other factors, including a spirit of nationalism in many of the conquered nations, created hostility toward France.

DOWNFALL OF NAPOLEON I. In 1813, following the disastrous defeat in 1812 of the imperial armies in Russia, Napoleon was confronted by a new coalition of powers, composed of Great Britain, Sweden, Prussia, Russia, and Austria. An army of the coalition won an overwhelming victory over Napoleon at Leipzig in October, 1813, forcing his withdrawal from central Europe. Pressing their advantage, the allied powers invaded France. Paris surrendered on March 30, 1814, and Napoleon abdicated one week later.

Restoration of the Bourbons. The victorious coalition, already in agreement on the policy pursued at the subsequent Congress of Vienna (see VIENNA, CONGRESS OF) of restoring the old order in Europe, bestowed the throne of France on the Bourbon pretender Louis XVIII. Commit-



Equestrian portrait, "Napoléon Bonaparte" (1799), by Jacques-Louis David. In 1804 David was appointed court artist. Alinari

ted to a constitutional monarchy, Louis entered Paris on May 2, 1814. France was stripped of Napoleon's conquests, but the peace terms imposed by the victors were otherwise lenient. The national boundaries in existence before the Revolution were allowed to stand.

Although Louis XVIII granted a constitution on June 4, 1814, his government contained many features, such as strict censorship and extensive police powers, reminiscent of the other Bourbons. Popular discontent within France soon provided Napoleon, in exile on the island of Elba, with the opportunity for which he was waiting. Escaping from Elba, he landed near Cannes on March 1, 1815. The French people, especially his former comrades in arms, greeted him with vast enthusiasm. Louis XVIII and his retinue fled from France shortly before Napoleon's triumphant arrival in Paris on March 20. In the ensuing period, commonly known in history as the Hundred Days (q.v.), Napoleon created new armies and then struck at the alliance which had been formed, in hasty consternation,

by Austria, Great Britain, Russia, and Prussia.

The campaign, which proved quite successful in its initial phase, ended in disaster on June 18 at Waterloo; see WATERLOO, BATTLE OF. Napoleon surrendered one week later, and Louis XVIII reentered Paris on July 8. The new peace conditions imposed on France by the Quadruple Alliance, which was dominated by the Austrian foreign minister Prince von Metternich (q.v.), contained many vindictive features, such as large indemnities, military occupation of certain parts of France, and the right to interfere in French internal affairs. The peace terms also forbade forever the occupancy of the French throne by any member of the Bonaparte family, a condition that later met effective opposition from the French political movement called Bonapartism; see BONAPARTISTS.

Soon after Louis' resumption of power, the ultraroyalist faction in governmental circles attained ascendancy, and the king's pledges of a more liberal policy were disregarded. In spite of Louis' promises of amnesty, many of Napoleon's

supporters during the Hundred Days were arrested and brought to trial before special tribunals. Michel Ney, a marshal of France, was convicted of treason and shot. In several parts of the country, Bourbon zealots instigated campaigns of violence and murder, known as the "White Terror", against republican adherents. The suffrage law was repeatedly modified, placing disproportionate power in the hands of wealthy landowners. Constitutional guarantees of civil rights were revoked, and the free press was throttled. A willing tool of the Holy Alliance, Louis' government dispatched a French army into Spain in 1823, crushing the revolutionary Spanish regime and restoring Ferdinand VII to the throne. Reaction became even more extreme in France during the reign (1824–30) of Louis' successor Charles X. On his recommendation, the national legislature, the Chamber of Deputies, voted to indemnify the dispossessed nobility with funds to be obtained by reducing the interest rate on government bonds. This move alienated the wealthy bourgeoisie, who, following the spread of the Industrial Revolution (q.v.) to France, had become the most influential group in national politics. In reply to a series of royalist moves to reinstitute absolutist rule, a section of bourgeoisie, supported by Parisian workmen, rebelled against Charles' regime in July, 1830, and overthrew it; see JULY REVOLUTION.

REIGN OF LOUIS PHILIPPE. The last of the Bourbons was replaced by Louis Philippe, Duc d'Orléans, who had fought against the monarchy in the French Revolution. Hailed as the "citizen king" by his supporters in the Chamber of Deputies, Louis Philippe functioned, almost from the beginning of his reign, on behalf of the conservative bourgeoisie. He remained within the framework of parliamentary government for the first six years of his reign, but thereafter usurped more and more of the constitutional authority. In foreign affairs, the king's policy was characterized by a policy of appeasement toward Great Britain. Algiers was subjugated in 1830. Dissatisfaction with the growing trend to absolutism infected large sections of the population, particularly the workers. Denied the voting franchise and resentful of the government's bias toward the moneyed classes, the industrial proletariat rallied behind the reform program of the leftist and centrist parties.

REVOLUTION OF 1848. Attempts by the government to suppress the opposition movement precipitated armed insurrection in Paris in February, 1848. Powerless before the revolutionary upsurge, which shortly inspired similar out-

breaks in many parts of Europe, Louis Philippe abdicated on Feb. 24. A provisional government, led by the Socialist leader Louis Blanc, took immediate steps to ameliorate the conditions of the workers. Control of the provisional government passed, early in May, to the newly elected constituent assembly. This body, consisting chiefly of representatives of the middle class, abandoned Blanc's program, provoking another uprising in Paris. The rebels were quelled after several days of sanguinary fighting.

The Second Republic. After the adoption, on Nov. 4, 1848, of a republican constitution which created a unicameral legislature and vested power in a president, a national plebiscite was held to fill the presidency. Louis Napoleon, nephew of Napoleon I, was elected on Dec. 10 by a huge plurality. He swiftly consolidated his popularity among French Roman Catholics by obtaining the restoration, through armed intervention in Rome, of the temporal power of Pope Pius IX (see *under* PIUS), who had been exiled by Italian revolutionaries. Somewhat less than three years after his election, the president, an avowed disciple of his late uncle and openly hostile to republican institutions, acquired dictatorial control of the nation by means of a coup d'état. He proclaimed himself emperor of France, as Napoleon III, on Dec. 2, 1852. In line with his established policy, he secured public approval in a sham plebiscite.

The Second Empire. The regime established by Napoleon III was an absolute monarchy, thinly veiled with republican trappings. Like Louis Philippe, Napoleon III strongly favored the financial and industrial interests. This policy stimulated a remarkable expansion of every sphere of the national economy. A large part of the funds required for the construction of the Suez Canal (q.v.) was easily raised by public subscription. Napoleon's diplomacy was deliberately designed to distract his subjects' attention from the debacle that had befallen French democracy. In 1854 he joined Great Britain in an alliance against Russia, then threatening the Turkish Empire. The Anglo-French victory in the resultant Crimean War (q.v.) added considerably to his prestige. In his next move, Napoleon supported Sardinia in the Italian war of liberation against Austria, a venture that added Nice and Savoy to the French Empire. Between 1863 and 1867 he attempted to establish Maximilian (q.v.), Archduke of Austria, as head of a dependent Roman Catholic empire in Mexico, but this project was frustrated by the Mexican people. Meanwhile, an organized movement antagonistic to the emperor's autocratic regime had ap-



Meeting of Napoleon III (left) and German Chancellor Bismarck after the Battle of Sedan (painted by the 19th-century German artist Wilhelm Camphausen, known for his paintings of battle scenes and other historical events of his time).

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peared in France. The movement won certain democratic concessions as early as 1862, and after the Mexican fiasco the drive for democratic reforms gained rapid momentum. Napoleon's prestige had been damaged also by the ineptitude of his diplomatic dealings with the Prussian prime minister Prince von Bismarck (q.v.), who, having secured French neutrality through vague promises to Napoleon of "territorial compensation", proceeded to attack and to defeat Austria in 1866. This victory transformed Prussia into the dominant power of central Europe and paved the way for the creation of the German Empire. Humiliated by Bismarck's contemptuous attitude toward France and confronted with militant political opposition on the home front, Napoleon determined to regain his lost prestige at the expense of Prussia. A dispute regarding the right of a Hohenzollern (q.v.) to the Spanish crown provided the opportunity for provocative diplomacy. Bismarck reciprocated, and the series of sharp exchanges between the two governments culminated in a declaration of war, in July, 1870, by

France; see FRANCO-GERMAN WAR. Within two months the Prussians, aided by the Germanic States, had routed the imperial armies, captured Napoleon, and laid siege to Paris. The Second Empire had survived the Battle of Sedan, fought on Sept. 1, by only two days; see SEDAN, BATTLE OF.

The Third Republic to World War I. On Sept. 4 the Parisian republicans, headed by Léon Gambetta, proclaimed the establishment of the Third Republic. The republicans formed a Government of National Defense pledged to continue the war against Prussia. Because of hardships resulting from the siege of Paris, repeated military reverses, and failure to obtain foreign support, the republican government came under the domination of a monarchist faction favoring peace. On Jan. 28, 1871, this faction arranged an armistice with the Prussians who ten days earlier had proclaimed the German Empire at Versailles. In the elections held on Feb. 8 for a National Assembly, its policy was approved by the electorate of all France except Paris. On Feb. 26 the new government of the Third Republic concluded a preliminary treaty of peace with the German Empire. By the terms of the treaty, France agreed to cede Alsace and part of Lorraine, to pay an indemnity of 5,000,000,000

francs, and to submit to German military occupation until the indemnity was paid. The capitulation to Bismarck's terms widened the split between the majority of the National Assembly and the Parisians, who also feared that reactionary elements in the Assembly contemplated a restoration of the monarchy. On March 18, 1871, the Parisian National Guard, consisting chiefly of workingmen, led an uprising against the national government. Influenced and guided to a large degree by the teachings and theories of the German political philosopher Karl Marx (q.v.), the rebels, after winning control of the city, organized a proletarian dictatorship; see COMMUNE OF 1871; INTERNATIONAL WORKINGMEN'S ASSOCIATION; THIERS, LOUIS ADOLPHE. The national government suppressed the revolt in May.

For nearly a decade after the formal conclusion of peace with Germany, the government of France was in the hands of the Monarchist Party, which had the support of the Roman Catholic Church. Comte Marie Edmé Patrice Maurice de MacMahon (q.v.), a monarchist, became president of the Republic in 1873. Constitutional legislation, enacted in 1875, established the parliamentary form of government. This system, similar to that of Great Britain, placed executive power under control of the majority party or bloc of parties in the lower house, or Chamber of Deputies, of a bicameral legislature. Important legislative functions were vested in the upper house or Senate. Led by Gambetta, the French Republican Party, a coalition of centrist and middle-class factions whose principal policy was anticlericalism, gradually won popular support, ending the immediate threat of a restoration. By 1879 the Republicans had secured control of both branches of the legislature, and from that time until 1914 they were the decisive political force in France. A multiplicity of other political parties, as well as divisions among the Republicans, developed, however, leading to the appearance of coalition governments (ministries or cabinets). Between 1871 and 1914, changes in the relative strength or the policies of the various political groups in the national parliament resulted in some fifty successive cabinets.

Under Republican control, the French government remained isolated from the main currents of international politics during the next decade, giving its attention chiefly to the expansion of the national economy and the acquisition of colonies. In 1881 the French military invaded Tunis, which was transformed into a protectorate. Between 1883 and 1885 France ex-

tended its control over Madagascar. Additional possessions were secured in Indochina, in west and equatorial Africa, and in other parts of the world, making France second only to Great Britain as a colonial power. Internal developments during the period included the growth of industry, agriculture, and foreign commerce; the strengthening of the national military establishment; and various social reforms, such as the ten-hour working day, recognition of the right of workers to organize, and curbs on clerical domination of the educational system.

The Third Republic escaped disaster by a narrow margin after the elections of 1889. Supported as a candidate to the Chamber of Deputies by the army, clerical groups, and the monarchists, General Georges Boulanger, who was an advocate of restoration and of a war of revenge against Germany, received broad popular support at the polls. An impending Boulangerist coup d'état was frustrated by a coalition of left-wing parties. Conspiracy charges were brought against Boulanger, who fled the country. The monarchist threat to the country was lessened further, in 1893, when Pope Leo XIII (see *under* Leo) urged the French clergy to support the constitution. French political strife, essentially a continuous contest between liberal and conservative coalitions for control of the government, for a long time thereafter occurred within the constitutional framework. The struggle lost none of its acrimonious flavor, however. In 1892 the conservative factions in parliament implicated a number of prominent Republicans in the so-called Panama scandal. This affair, involving bribery and corruption in connection with efforts to construct a canal across the Isthmus of Panama, paved the way for a succession of moderate, or centrist, ministries. Before the turmoil and recriminations surrounding the Panama scandal subsided, French reactionaries injected anti-Semitism (q.v.) into national politics, charging that the Jews were engaged in a treasonable conspiracy on behalf of Germany. The conviction and condemnation in 1894 of Alfred Dreyfus, a Jewish captain in the French army, on charges of betraying military secrets to the Germans, generated a political crisis which verged at times on civil war; see DREYFUS AFFAIR. In the controversy that developed around demands for a retrial of the Dreyfus case, the anti-Semitic forces, including royalists, sections of the clergy, and important army leaders, were finally defeated, in 1899, by a broad coalition of progressive parties, which succeeded in forming a government of "national defense", committed to a program of democratizing the army and fur-

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ther restricting the political influence of the clergy. The government granted executive clemency to Dreyfus and secured enactment, two years later, of legislation called the Association Laws, which brought religious congregations under the supervision of the state. Following the elections of 1902 a new progressive ministry came into office; it was made up of Socialists, who had recently emerged as a strong force in French politics (see SOCIALISM), and Radical-Socialists, a more moderate grouping. This ministry obtained approval of additional anticlerical measures, including a law that ended religious control of the national educational system. All ties between the state and religious denominations were severed by the terms of subsequent legislation.

In foreign affairs France had meanwhile been drawn into the diplomatic drive to counter German hegemony in Europe. An alliance with Russia was contracted in 1893–94. This break with the isolationist policy that had followed the defeat of 1870 was motivated by various considerations, including traditional fear of German intentions with respect to France, desire for the return of Alsace and Lorraine, and, of more immediacy, the Triple Alliance (q.v.) of Germany, Austria-Hungary, and Italy. In 1904 the French government improved its position on the international scene by concluding an understanding with Great Britain. The agreement, arranged by the French foreign minister Théophile Delcassé, considerably lessened Anglo-French colonial rivalry. By its chief provision France recognized the paramountcy of Britain in Egypt, in exchange for British support of French objectives in Morocco. The German Empire, provoked by this bilateral agreement and taking advantage of the new power structure created by the Russian defeat in the Russo-Japanese War, challenged the validity of the Anglo-French pact on Morocco and demanded that the Moroccan question be settled on an international basis. Delcassé's advocacy of rejection of the German demands was repudiated by the French government, which accepted his resignation in June, 1905. Although the subsequent Algeiras Conference endorsed the special position of France in Morocco, the German government, in 1911, raised strong objections to French activities in that region, causing another dangerous crisis. On this occasion France obtained German recognition of its plan to establish a Moroccan protectorate by ceding 107,270 sq.mi. of territory in the French Congo to Germany.

The recurring crises between France and Germany represented merely one aspect of the

steady drift toward a general European conflict. In 1907, following the formation of the Triple Entente (q.v.), which brought Russia into the Anglo-French coalition against the Triple Alliance, the European diplomatic situation was one of armed truce, marked by intensive preparations for war. Austro-Hungarian moves, supported by the German Empire, to obtain hegemony in the Balkan region aggravated Continental tensions. The spark that set off the explosive compound was provided by the assassination of Francis Ferdinand (q.v.), Archduke of Austria, by a Serbian nationalist. European diplomacy proved incapable of finding a satisfactory solution of the ensuing dispute, and on July 28, 1914, the Austro-Hungarian Empire declared war on Serbia. The Russian Empire mobilized its armies on the following day, and on Aug. 1, Germany declared war on Russia. Mobilization of the French armies on Aug. 1 brought an immediate German declaration of war on France. Three days later, Great Britain entered the conflict now generally referred to as World War I.

World War I. In the early stages of the war the French people, hopeful of a quick victory, responded to the national emergency with patriotic fervor. The parliamentary factions, including the Socialists, abandoned partisan strife; and the clergy, although traditionally hostile to the Third Republic, rallied to the defense of the nation. A representative cabinet, headed by René Raphaël Viviani (1863–1925), guided the war effort until October, 1915, when a new coalition government was organized by Aristide Briand. This event, which signaled a serious rupture of the parliamentary truce, was symptomatic of the popular discontent that gained headway as the conflict developed into a war of attrition. By the spring of 1917, swollen casualty lists and severe economic difficulties had brought a widespread defeatist mood and increasing industrial unrest to France. Sections of the Socialist Party adopted a policy of opposition to the war. A group of Radical-Socialist politicians, led by Joseph Caillaux, launched a campaign for a "peace without victory". In November, 1917, Georges Clemenceau, a French senator and former premier, forced the dissolution of the incumbent cabinet and accepted the responsibility of forming a new government. Clemenceau, who advocated prosecution of the war to a victorious conclusion, took energetic steps to forestall a national breakdown, striking first at the defeatist movement; a number of its leaders, including Caillaux, were arrested for treason and several were convicted and executed. Having checked the antiwar movement, Clemenceau



The "Big Four" of the Paris peace conference, whose signing of the Treaty of Versailles with Germany in 1919 initiated the formal end of World War I, were (seated left to right) Vittorio Orlando of Italy, David Lloyd George of Great Britain, Georges Clemenceau of France, and Woodrow Wilson of the United States.

U S National Archives and Records Service

mobilized the nation for the effort and sacrifices necessary for victory.

The human, material, and financial costs of World War I to France were enormous. More than 73 percent of its military personnel, which totaled about 8,410,000, were casualties, and of these about 1,358,000 lost their lives. Many French communities were in ruins or badly damaged, and the national war debt was of astronomical proportions. The amount owed to the government of the United States alone totaled nearly \$5,000,000,000.

Post-World War I. The period following World War I was one of acute economic distress, highlighted by grave budgetary deficits, mounting taxation, instability of the franc, and inflation. These problems provided, to a large degree, the domestic political issues of the post-war period. The resultant parliamentary factional strife, accompanied by the rise and fall of successive coalition ministries, reflected a further differentiation between the left and right political groupings in France. Chief factions were the General Confederation of Labor, a national association of French trade unions, founded in 1895 and the major source of strength of the French Socialist Party and the French Communist Party, an affiliate of the Third International (q.v.), with growing popular support.

French foreign policy in this period was largely determined by the decisions of the Allied peace conference, which convened at Versailles on Jan. 18, 1919, to draft peace conditions for the defeated Central Powers. Clemenceau, one of the dominant statesmen at the conference, advanced and secured approval of demands which were contrary in spirit and substance to the Fourteen Points (q.v.) of President

Woodrow Wilson (q.v.) of the U.S. Clemenceau's program of vindictive reprisals against the vanquished nations was designed to aggrandize France at the expense of Germany, to insure French hegemony on the continental mainland, and to saddle Germany with the costs of the war. His objectives were accomplished by the Treaty of Versailles (see VERSAILLES, TREATY OF), which contained the German peace terms, and by the treaties imposed on the German allies (see treaties of NEUILLY; SAINT GERMAIN; TRIANON). Besides the return of Alsace-Lorraine and control of the rich coal fields of the Saar basin, French gains under the Treaty of Versailles included vast reparations (q.v.), a number of German colonial territories, and other valuable economic, political, and military advantages; see VERSAILLES, TREATY OF.

On the adjournment of the peace conference, French diplomacy was committed, as a matter of national security and survival, to the maintenance of the new status quo in Europe. By traditional concepts, this objective could be realized solely through a system of international agreements and alliances among states with identical or similar aims; see LITTLE ENTENTE. The long record of failure on the part of the statesmen of France and of countries concerned, like France, with preventing a resurgence of German power, constitutes much of the political history of Europe in the two decades following Versailles; see EUROPE: *History, Modern*; LEAGUE OF NATIONS

The disintegration of French foreign policy

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paralleled and, to an important degree, resulted from mounting social and political antagonisms in domestic affairs. Clemenceau's repressive measures against the General Confederation of Labor, which initiated widespread strikes in February, 1920, deepened class cleavages in the nation. Mass want, a by-product of the dwindling value of the franc, higher taxation, and other economic difficulties reduced the popular following of the conservative parties. Because of widespread disillusionment with the peace settlement and because of the fiscal problems resulting from German defaults on reparations, parliamentary coalitions among the right and centrist parties became increasingly unstable. The ministry of Raymond Poincaré, established early in 1922, employed aggressive tactics both at home and abroad in a sustained attempt to bring Germany to terms and to resuscitate the national economy. In the elections of May, 1924, the coalition supporting Poincaré's program lost a number of seats in the Chamber of Deputies to the radical and moderate parties. The new ministry, formed in June, with the Radical-Socialist Édouard Herriot as premier, promulgated a generally progressive program, notable for a friendly attitude toward Germany, recognition of the U.S.S.R., and a return to anticlericalism, particularly in Alsace-Lorraine. Herriot's inability to solve the national economic crisis, which had been intensified by an exodus of French capital, brought about the downfall of his ministry in April, 1925. During the next fifteen months the decline in value of the franc continued, causing the collapse of four successive ministries.

In July, 1926, representatives of the major conservative and moderate parties organized a government of "National Union", headed by Poincaré. The national legislature gave speedy approval to Poincaré's program, which included proposals for increased taxation and measures beneficial to the financial community. The franc rapidly recovered and the budgetary situation improved. The parties of the left opposition made political capital of Poincaré's support of a measure providing for part payment of the American war debt. Adoption of the measure, in July, 1929, climaxed more than two years of bitter controversy, during which anti-American feeling in France reached serious proportions. Throughout Poincaré's premiership, which ended in July, 1929, and until 1932, French diplomacy was directed by Aristide Briand, an advocate of a federation of European states, including Germany. The coalition of moderate and conservative parties retained control of the government until the elections of May, 1932. In

these elections the French electorate shifted sharply to the left, giving the Socialists and Communists a combined majority. Because of differences between these groups and the refusal of the Socialists to participate in a coalition cabinet with the centrists, the Radical-Socialist Party came to power. Led by various premiers, including Paul Painlevé, Édouard Herriot, Camille Chautemps (1885-1963), Pierre Laval, Édouard Daladier, Gaston Doumergue (1863-1937), and Pierre Flandin (1889-1958), Radical Socialist ministries governed France until June, 1936. The chief issues with which France was confronted in the decade preceding World War II were as follows: (1) deficits in the budget, a steadily increasing public debt, and unstable commercial conditions; (2) deep-seated political unrest; (3) the advent of the Popular Front government and its frustrated efforts to introduce social reforms; (4) apparent tragic decline in French power simultaneous with the rise of Hitler in Germany.

(1) With the end of reparations payments in 1932, the French economic situation changed completely. Before 1932, the French still trusted that German payments would balance high taxation, but when the payments ceased, her economic scheme almost collapsed. For a time, France had a gold reserve second only to that of the U.S. Difficulties in competing with the devaluated British pound and the American dollar, the decline in tourist trade, and the problem of coping with the effects of the world economic depression, which hit France as late as 1934-35, finally forced devaluation of the franc.

In 1936, the year of the inauguration of the first Popular Front Government, the gold reserve had sunk to about 50,000,000,000 francs and devaluation was inevitable; the gold content of the franc was reduced by 30 percent. In less than a year, French credit had reached its lowest point since 1926. Unable to maintain the franc on a stable level, in June, 1937, the government permitted the franc to seek its own level in international markets. Financial problems seemed only to increase, however, and in 1938 the franc was devaluated again.

(2) Dissatisfaction with existing political institutions had been growing for some time when the Stavisky scandal of 1934 precipitated a crisis. Serge Alexandre Stavisky (1886?-1934) was an international adventurer, gambler, and swindler who set up a municipal pawnshop in Bayonne and through this office sold to numerous French investors, chiefly of the poorer classes, bonds with a face value of 500,000,000 francs though actually almost worthless. The fraud was discov-

ered when Stavisky disappeared in December, 1933. Trained by the police, he committed suicide before he could be arrested. The main significance of the fraud was the implication of cabinet members and other high functionaries. This episode forced the resignations of Premier Chautemps and his cabinet. Édouard Daladier, Chautemps' successor, formed a new cabinet which suddenly ended on Feb. 7, after renewed and severe rioting resulted in many casualties. The unrest finally subsided with the formation of a cabinet of national unity under the former French president Gaston Doumergue. Conflicts between radical factions, however, kept France in a constant state of ferment and forestalled any improvements in business and economic conditions.

The dangerous attitude of rightist and royalist groups in attacking the liberties of the Republic and the small gains of the working classes prompted a coalition of the Left. The Socialists under Léon Blum, the Communists, and at first the left wing of the Radical-Socialists and later the whole party, established the so-called Popular Front, which gained a majority in the elections of 1936. Unfortunately, strikes which broke out at this time prejudiced and aroused the wrath of industrialists and the upper middle class, and France once again was split into warring factions. The "inciting to riot" attitude of a strong rightist group under François de la Rocque (1886-1946), which early in 1937 resulted in the killing of five workers and the wounding of more than 300, was an example of the hostility exhibited toward the Left. This battle of Right against Left continued until World War II, which brought an end to open hostility if not to undercover enmity.

(3) The Radical-Socialists under Édouard Daladier, who had taken over leadership of the party early in 1936, the Socialists, and the Communists agreed on a program of union for the general elections of 1936. Opposing fascism in any form or disguise, promising defense of democratic ideals, and fighting deflation and defeatism as practiced by the governments previously in power, the leftist coalition called for a planned economy and pledged destruction of the economic and financial oligarchy which was preventing social reform. In foreign policy the Popular Front proposed adherence to the League of Nations' covenant and denounced aggression.

The Popular Front election gains were beyond expectation. The combined parties won 381 of 618 seats in the Chamber of Deputies. The victory of the Left, however, was accompanied by a

flow of gold and capital out of the country, and the wealthier classes displayed a hostile attitude toward the new cabinet formed by the Socialist leader, Léon Blum, in June. Before the Popular Front government was installed, large-scale "stay-in" strikes broke out. Social reforms, such as the forty-hour week, wage increases, paid vacations, and improved working conditions, went into effect and the strikers returned to the factories. Strikes revived sporadically, however, and as the year progressed a new obstacle to social improvements developed when increased industrial wages were offset by rising prices.

The Popular Front nationalized the Bank of France and most of the nation's armament works, and state control of the coal industry was established. A public works program was set up and aid to agriculture was inaugurated. The cost of the new measures was estimated by the *London Times* as being, in all, 11,000,000,000 francs. Although some expenditures were self-liquidating, they added greatly to the immediate strain on the already burdened treasury. The first Popular Front and following governments made provisions for armament expansion, necessitated by the growing menace of Germany.

During the first months of the new coalition, exports declined alarmingly; the gold reserve decreased to a point less than considered necessary to support the franc at its normal level and devaluation became inevitable.

The economic structure of France, which was unprepared to bear the burden imposed by the social measures of the Popular Front, contributed to the severe decline in business conditions. In addition, the militant antagonists of the Popular Front continued to obstruct Blum's measures, although, in March, 1937, Blum announced a so-called breathing spell in his social reforms. Blum was forced out of office in June, 1937, and Camille Chautemps, a moderate Radical-Socialist, formed another Popular Front government with Blum as vice-premier and Blum's strongest financial critic, Georges Bonnet (1889-1973), as minister of finance. The policy of the new cabinet was far less radical than that of the Blum government.

The Socialists and Communists again demanded social reforms, especially exchange control to prevent capitalists from "sabotaging" the social program by exporting their funds, a practice which they claimed had brought the treasury again and again to the breaking point, and had forced devaluation of currency. Chautemps resigned in January, 1938; he formed a new cabinet immediately thereafter but remained in power only two months longer.

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A second Blum government of Socialists and Radical-Socialists, supported by Communists, followed, but Blum's premiership was doomed from the start. A new wave of strikes and lock-outs broke out and armament and aircraft industries were virtually paralyzed at a time when production of war materials had already fallen far behind that of the totalitarian states. Blum's comprehensive plan for economic and financial rehabilitation under decree powers was refused by the Senate, and in less than a month his government was replaced with one led by Édouard Daladier, which marked the final collapse of the Popular Front.

Daladier, a conservative Radical-Socialist who had gained wide popularity as minister of war, a position he had held several times alternately with the premiership, formed a cabinet composed of members of his party and representatives of several centrist parties. Daladier elaborated a program calling for increased industrial production, a balanced budget, encouragement to expatriated capital to return by affording opportunities for profitable investment, and a new devaluation of the franc to raise production and revive foreign trade. The government revised the forty-hr. week and took firm measures to end strikes; a strike called in protest to these measures was soon liquidated. The Daladier government remained in power, with only minor changes, until March, 1940, when it was superseded by a cabinet under Paul Reynaud (1878–1966), who had served as minister of finance under Daladier.

(4) The end of German reparation payments in 1932 and the rise of the nationalist movement in Germany marked the start of the decline of French influence in world politics; see **FASCISM**; **NATIONAL SOCIALISM**. Beset by domestic discord, British "isolationism", and a resurgent Germany, the French foreign office proved incapable of dealing with the series of crises that followed the occupation by the German dictator Adolf Hitler (q.v.) of the Rhineland in 1936, and his simultaneous denunciation of the Locarno Pact of 1925. The transition from diplomatic paralysis to acceptance and support of the British appeasement policy, which developed rapidly after the Italian invasion of Ethiopia in 1935, met little effective opposition among French political leaders. Appeasement—the calculated policy of surrendering to the demands of Hitler and his Italian colleague Benito Mussolini (q.v.) in an effort to halt or divert their aggressions—first became a decisive factor in European affairs during the Spanish Civil War fought from 1936 to 1939. The German and Italian governments

actively intervened in the struggle between the Spanish Republic and Fascist rebels, supplying the rebels with troops and military equipment. The French government, however, then under the premiership of Léon Blum, supported the so-called nonintervention policy of the British premier Neville Chamberlain (see under **CHAMBERLAIN**). Nonintervention, by its denial of aid to the Spanish Republic, led to the victory and dictatorship in Spain of the insurgent leader Francisco Franco (q.v.). Throughout 1938 the French government continued its diplomatic retreat, submitting to German annexation of Austria in March and, six months later, to the partition of Czechoslovakia, one of the staunchest allies of France in eastern Europe; see **MUNICH PACT**.

Not having come to an agreement with Italy, which had for some years been demanding Tunis, Corsica, Nice, and Savoy, as well as commercial advantages in French African colonies, France moved close to England and Poland to avoid being trapped if Germany should break through in the West. The failure of negotiations among France, Great Britain, and the U.S.S.R. for collective action against German aggression, and the subsequent announcement of the Soviet-German nonaggression pact, climaxed the French diplomatic retreat. Bound, like Great Britain, to defend Poland in the event of German aggression, France was drawn into the maelstrom of World War II when, on Sept. 1, 1939, the armies of Hitler crossed the Polish frontier.

World War II. The Third Republic capitulated in the first year of the war. On May 10, 1940, the Germans launched their long-expected offensive against France and the Low Countries. Within a month the British Expeditionary Force was evacuated at Dunkirk (q.v.), and the French armies were in headlong retreat. On June 12 General Maxime Weygand (1867–1965), the commander in chief of the Allied armies, advised the French government, then headed by Paul Reynaud (1878–1966), against further resistance. Paris, previously proclaimed an open city, was occupied by the Germans on June 14. Seeking British approval of a proposal that France conclude a separate peace, Reynaud had meanwhile opened negotiations with the British prime minister Winston Leonard Spencer Churchill (q.v.). British counterproposals, including one projecting an "indissoluble union" of the French and British empires, were rejected by the French government, and on June 16 a majority (13 to 11) of the Reynaud ministry, then in session at Bordeaux, voted to withdraw from the war. Reynaud resigned at once, whereupon

a new government was organized by Marshal Henri Philippe Pétain, one of the outstanding French military leaders of World War I. On June 22, at Compiègne (q.v.), delegates of the Pétain ministry signed armistice agreements with Germany and Italy. Italy had declared war on France and Great Britain on June 10, 1940. Among other provisions, the Franco-German agreement included German military occupation of the northern half of France and the entire French Atlantic seaboard, French responsibility for the costs of the occupation, and demobilization of the French navy. Italy retained control of the areas taken by its armed forces, a broad zone along the Franco-Italian frontier was demilitarized, and various zones in the French colonial territories in Africa were demilitarized.

Two days before the conclusion of the armistice agreements, nearly one hundred French deputies and senators, all of whom opposed capitulation to the Germans, left France for Morocco. Pierre Laval, widely known in France as an opportunist and a fascist sympathizer, replaced Chautemps as vice-premier of the Pétain government on June 23. On the same day, General Charles de Gaulle, who had been undersecretary of war in the Reynaud ministry, announced from London the establishment of a French National Committee pledged to continue the war. The British government formally recognized the Committee on June 28. Fearing Pétain's cooperation with the Germans, British naval forces, on July 3, attacked and destroyed important units of the French fleet at Dakar and Oran. In consequence, most of the French authorities in north Africa adopted a hostile attitude toward Great Britain and the de Gaulle Committee. French officialdom in practically all of the other colonies, including Indochina and Syria, and a majority of the prominent politicians and generals remaining in France quickly rallied to Pétain's support. De Gaulle, however, managed to secure control of French Equatorial Africa and several smaller colonial areas.

Vichy Government and Resistance. On July 10, 1940, the remnants of the French parliament, meeting in Vichy (q.v.) as a National Assembly, voted 569 to 80 for a resolution that virtually abrogated the constitution of 1875, and Pétain, as chief of state, received almost unlimited dictatorial authority. Pétain immediately began the transformation of unoccupied France into a regime closely patterned after the Hitler regime in Germany. Besides instituting repressive measures against opposition movements, the government placed under arrest many moderate and radical political leaders of the old regime, in-

cluding Daladier, Reynaud, and Blum. Anti-Semitic regulations, similar to those in effect in the occupied zone, were promulgated and numerous privileges of the Roman Catholic Church were restored. General de Gaulle was sentenced to death, in absentia. These events and the harshness of German rule in the occupied zone enhanced the prestige of de Gaulle's government-in-exile. With French military units that had escaped to Great Britain, de Gaulle established the nucleus of a new French army, known as the Free French (q.v.). This force, later called the "Fighting French", was constantly reinforced by refugees in flight from France or the colonies.

After the formation of the Vichy government, the Germans pressed Pétain for closer collaboration in the war against Great Britain, using occupation costs and the status of nearly 2,000,000 French prisoners of war as their principal bargaining points. The negotiations with the German authorities were conducted chiefly by Laval, who favored a policy of full cooperation with the Germans. As a result of differences between Pétain and Laval on the question, Laval was dismissed (Dec. 14) from the Vichy government. Rejecting German demands for military and naval aid, Pétain confined French collaboration to the economic sphere for the next few months.

Admiral Jean Darlan, who shortly became second only to Pétain in the Vichy government, greatly extended the area of French collaboration with the Germans in secret negotiations completed on May 7, 1941. In exchange for certain advantages in North Africa and other concessions, the Germans reduced their occupation charges by about \$2,000,000 daily. Eight days later, Franklin Delano Roosevelt (q.v.), President of the U.S., which had maintained diplomatic relations with the Vichy regime, appealed to the French people to reject the policy of collaboration with the Germans. The U.S. government simultaneously seized all French-flag ships in American ports. Some opposition to the Darlan program subsequently developed in leading French circles, but following the German invasion of the U.S.S.R. on June 21, relations between the Vichy and Hitler governments grew steadily closer. The French government severed relations with the U.S.S.R. on June 30, and on July 29, French Indochina was placed under the protection of Japan.

Within a few weeks after the German attack on the U.S.S.R., the French underground movement of resistance to the German occupation had attained a new level of activity. Acts of vio-

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lence against the German military and against pro-German Frenchmen, sabotage of the French railroad system, and bombings and arson of German-controlled installations became increasingly frequent thereafter. In reprisal, the Germans seized thousands of French Communists, Jews, and other citizens as hostages, who were systematically shot in a ratio ranging from about 20 to 100 for each German death. Pétain denounced the resistance movement, and the Vichy government organized special courts in the occupation zone for the purpose of dealing with hostile elements. More than 30,000 so-called Communists were penalized by the Vichy courts during the first two weeks of October, 1941. Despite these repressive German and Vichy measures, anti-German manifestations attained wider scope, particularly after the German-Italian declaration of war on the U.S. on Dec. 11, 1941.

Early in 1942 the Vichy government placed on trial Reynaud, Daladier, Blum, and various other persons prominent in the Third Republic. The defendants, charged with responsibility for French defeat in the war, turned the proceedings into a forum against their accusers, presenting evidence that the military disaster that befell France resulted from the acts and policies of Laval, Pétain, and their associates. Official adjournment of the trial on April 2 precipitated a crisis in the relations of the Pétain regime with the Germans, who were not only dissatisfied with the handling of the case but had demanded that the defendants be charged with provoking the war. Accordingly, the Germans subjected Pétain to intense pressure for greater help in their war effort. They shortly succeeded in reinstating Laval to power in the Vichy government. The Pétain cabinet was reorganized on April 18, with Laval designated as "Chief of Government" and vested with complete authority to carry through his program of close collaboration with the Third Reich. Mobilization of French workers for service in German war plants was one of the central features of Laval's program. In consequence of Pétain's surrender to German demands and of Laval's policies, the French resistance movement accelerated its campaign of terror against the occupation forces. The Germans retaliated by increasing the scale of mass executions of hostages. Having failed to round up more than 20,000 volunteers for German industry, Laval resorted, in September, to conscription of workers. Many able-bodied Frenchmen then went into hiding with the Maquis, as the underground resistance fighters were popularly known.

The difficulties besetting the Vichy government multiplied tremendously following the Anglo-American invasion of Algeria and Morocco on Nov. 7, 1942. Pétain immediately severed diplomatic relations with the U.S., and four days later Admiral Darlan, the ranking Vichy official then in north Africa, ordered cessation of French resistance. The initial defection of Darlan heralded a series of anti-Vichy moves on his part, including the organization of a separatist North African regime friendly to the democratic powers. Alarmed at the Anglo-American successes in north Africa, the German and Italian governments nullified their armistice agreement of 1940 and began, on Nov. 11, the occupation of Vichy France. Only Toulon, where numerous units of the French Navy were concentrated, remained under French control on the completion of this operation. Following an ineffectual protest to the German government, Pétain delegated most of his authority to Laval and went into virtual retirement. On Nov. 27, German troops attacked Toulon in a surprise attempt to seize the French fleet. This move was aborted by French naval personnel, who scuttled and otherwise put out of action nearly 200,000 tons of war craft.

Under General de Gaulle, the French National Committee had meanwhile reached policy agreements with the various underground groups in France; considerably broadened its political base by the inclusion of representatives of the Communist, Socialist, and other political factions; and substantially strengthened its armed forces. The Fighting French adopted an antagonistic attitude toward Admiral Darlan, whose separatist government of north and west Africa began to function on Dec. 1, 1942. Following Darlan's assassination on Dec. 24, however, de Gaulle and Darlan's successor, General Henri Honoré Giraud, opened negotiations toward the unification of their respective organizations. Wide political differences between the two leaders, who were brought together for the first time by President Roosevelt and Prime Minister Churchill during the conference, in January, 1943, at Casablanca (q.v.), could not be reconciled for several months. A settlement was finally reached, and on June 3, 1943, the two groups merged as the French Committee of National Liberation, with de Gaulle and Giraud as

Opposite page: Defeat and victory in World War II. Above: Adolf Hitler shows his glee after France accepted German armistice terms at Compiègne in 1940. Below: General Charles de Gaulle (in uniform), the Free French leader, celebrates the liberation of Paris from German occupation in August, 1944.



Wide World

French Embassy Press & Information Division



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cochairmen and with headquarters at Algiers. Partisan strife between the Giraud faction, which retained many links with the Vichy regime, and the Gaullists continued, with de Gaulle gradually gaining control of the Committee. On Nov. 6 Giraud resigned as cochairman.

In the period following German-Italian nullification of the armistice agreement, conditions within France had deteriorated disastrously. Resistance sabotage, the blockade of French ports, the closing of French factories, the mass deportations of industrial and agricultural workers, and other measures undertaken by the German and Vichy governments had totally disrupted the national economy. By the middle of 1943, nearly 1,000,000 workers had been rounded up by Laval's police and German pressgangs and deported to Germany, and, by the end of the year, mass executions of hostages in reprisal against the Maquis had victimized an estimated 50,000 Frenchmen. Adding to the social and economic chaos, the Anglo-American air forces began, in 1943, the systematic bombing of German military and naval bases in France and of French industrial establishments engaged in the manufacture of war materials. The tempo of these air attacks, which incalculably damaged many French communities, attained a climax during the months immediately preceding the allied invasion of Normandy on June 6, 1944. After the invasion, numerous other French towns and cities were destroyed or damaged by shellfire and bombings.

The liberation of France, completed, except for a few isolated pockets of German resistance, by the end of August, was facilitated by units of the Fighting French and the Maquis. General Dwight D. Eisenhower (q.v.) of the U.S., the supreme allied commander, had previously granted the Maquis official military status as French Forces of the Interior (F.F.I.). Together with American and Fighting French contingents, the F.F.I. liberated Paris on Aug. 23. Laval, Pétain, and their chief colleagues fled eastward with the retreating Germans. Many collaborationists captured by the F.F.I. were summarily tried and executed in the period before legally constituted courts began to function. Beginning early in September, thousands of Vichyites were arrested.

Postwar Governments. On the initiative of General de Gaulle, the French Committee of National Liberation had meanwhile, on May 15, declared itself to be the Provisional Government of the French Republic, which subsequently received de facto recognition from the British and U.S. governments. The Provisional

Government, with de Gaulle as president, assumed administrative control of France at Paris on Aug. 30. Cabinet posts in the new ministry were distributed about equally among leaders of the government-in-exile and representatives of the resistance movement. In its political complexion, the ministry closely resembled the Popular Front coalition of 1936-37, and included Communists. The resistance movement shortly obtained broader representation in the cabinet. On Sept. 9 Georges Bidault, a distinguished leader of the underground movement, was appointed minister of foreign affairs. The resistance movement also became the dominant force in the Provisional Consultative Assembly, an advisory body composed of delegates from the various political parties, labor organizations, and resistance groups. By general agreement, plans for national elections were held in abeyance pending the repatriation of prisoners of war and deportees, who together totaled about 2,500,000. The Provisional Government received de jure recognition from the U.S., Great Britain, and the Soviet Union on Oct. 23.

Relations among the diverse factions comprising the government coalition were harmonious during its first year. The Provisional Government concluded a twenty-year treaty of alliance with the Soviet Union on Dec. 10, 1944. On June 26, 1945, at San Francisco, France signed the Charter of the United Nations (q.v.) organization. Contingents of the French army participated in the final phase of the war against Germany, which surrendered unconditionally on May 8, 1945. By the terms of the Potsdam Declaration (see POTSDAM CONFERENCE), France was assigned a zone of occupation in western Germany, which included the Palatinate, the Saar district, Baden, and part of Bavaria. Part of Berlin, designated as joint headquarters of the occupying powers, was also allocated to French military control.

Domestic developments in France immediately following the collapse of Germany centered chiefly around such pressing issues as economic rehabilitation, the prosecution of traitors, and preparations for the national elections. After a trial extending from July 23 to Aug. 15, Pétain was adjudged guilty of "intelligence with the enemy" and sentenced to death. President de Gaulle, on the recommendation of the court, commuted the sentence to life imprisonment. On Oct. 9 Laval was convicted of treason and sentenced to death; he was shot on Oct. 14.

In the national elections on Oct. 21, the French electorate chose a National Assembly. The voters also decided, by referendum, that

the National Assembly should simultaneously function for seven months as a Constituent Assembly, with the task of drafting a new constitution, and as a national parliament, with qualified powers to control the government and to legislate. In the choice of candidates, the voters of metropolitan France revealed a sharp leftist orientation, electing 142 Communist and 133 Socialist deputies. The Mouvement Républicain Populaire (M.R.P.), a new party composed mainly of liberal and centrist Roman Catholics, won 140 seats in the Assembly. Only 19 Radical-Socialists were elected, and the remainder of the 522 seats allotted to metropolitan France was won by moderate and miscellaneous groups. On Nov. 13 the National Assembly unanimously elected de Gaulle president-premier of the provisional government. He selected a ministry representative of the major parties.

The election of de Gaulle was virtually the last display of parliamentary unanimity in the post-war period. Factional dissension, highly reminiscent of the final years of the Third Republic, characterized the French political scene during the Fourth Republic as well. The period was one of bitter rivalries and unstable coalitions among the principal political groups. De Gaulle, the first victim of the partisan strife, resigned from his post on Jan. 20, 1946, because of leftist opposition to his proposals for large armament expenditures. The new premier, Félix Gouin (1884–), a Socialist, maintained the three-party-coalition ministry.

By the completion on May 28 of negotiations with the U.S. for a loan of \$1,400,000,000, the Gouin ministry ameliorated somewhat the desperate plight of the national economy. Shortages of consumer goods and coal, spiraling inflation, low wages, a widespread black market, and the need for industrial equipment had brought the country to the verge of bankruptcy. The chief domestic development during Gouin's tenure was the rejection by voters, on May 5, of the draft constitution of the Fourth Republic. On June 2, elections were held for a new National Assembly, charged with the task of preparing a new draft. The M.R.P., which had campaigned against acceptance of the constitution, increased both its popular vote and the size of its Assembly delegation, chiefly at the expense of the Socialists. After a protracted deadlock, during which the Communist-dominated General Confederation of Labor organized mass demonstrations for wage increases, Bidault (q.v.), a member of the M.R.P., obtained majority support in the Assembly and formed, on June 24, a new coalition ministry, repre-

senting the major parties. A second draft constitution, similar in all important respects to the first, received approval of the electorate on Oct. 13, and was officially promulgated on Oct. 27. **The Fourth Republic.** In an election for the first National Assembly of the Fourth Republic on Nov. 10, the Communist Party won 169 seats, gaining 23, and the M.R.P. won 163, gaining 3. Socialist representation dropped from 115 to 103. During the campaign the M.R.P. demonstrated its hostility to the Communists, increasing partisan friction in the Assembly. The Socialist Party, in an intermediate position between these warring factions, finally succeeded in forming an all-Socialist ministry on Dec. 16, with Léon Blum as premier. Both the Communist and M.R.P. delegations in the Assembly voted to support Blum's ministry. Ill health forced Blum to resign early in January, 1947. In the interim, he had instituted moderate wage increases, proclaimed a 5 percent reduction in prices, and generally created optimism in France. On Jan. 17 Vincent Auriol (1884–1966), first president of the Fourth Republic, delegated the responsibility of forming a new government to Socialist Paul Ramadier (1888–1961). On Jan. 22 Ramadier, aided by the spirit of harmony then prevailing in French politics, established a ministry composed mainly and about equally of Socialists, Communists, and M.R.P. members.

Political harmony was sporadic during the Fourth Republic. In the early postwar years, every political faction clung to favored remedies for the ravaged French economy. Furthermore, the rise of nationalist revolts in French overseas territories in north Africa and Asia, and the intensification of differences between the U.S.S.R. and both the U.S. and Great Britain caused increasingly bitter political disputes in Paris. These disputes, in turn, caused the fall of successive ministries for lack of parliamentary support.

Communist opposition to the French association with the Truman Doctrine, the American policy, enumerated in March, 1947, to halt the spread of communism in Europe, and to the Marshall Plan (see EUROPEAN RECOVERY PROGRAM) brought down the Ramadier Ministry in November, 1947. Robert Schuman (1886–), a leader of the M.R.P., organized a new coalition consisting of Socialists, Radical-Socialists, and M.R.P. members. Schuman called this coalition the "third force" in French politics, opposed to both the Communists and to de Gaulle, whose supporters had formed the rightist Rally of the French People earlier in the year.

The political instability characteristic of the

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Fourth Republic was a reflection of the failure of successive governments to deal effectively with a continuing inflationary crisis. In September, 1948, Henri Queuille (1884–1970), a relatively unknown Radical-Socialist, formed a coalition cabinet to succeed Schuman. Queuille inaugurated a vigorous program of anti-inflation measures, including high taxes on consumer goods and restrictions on wage and price increases. Premier Queuille remained in office for more than a year, partly because his anti-inflation program stopped the continuing rise in the cost of living, and partly because industrial production and trade, stimulated by assistance from the European Recovery Program, had increased. Nevertheless, the Queuille government was frequently attacked for its policies, and his ministry fell as a result of a disagreement within the coalition on a question of wage increases for low-income workers.

Despite the rapid economic recovery during the 1950's, succeeding premiers faced a variety of national crises, many of which had roots in such questions as minimum hourly wage rates for public service employees. And, although French foreign policy was relatively consistent, ministries fell over foreign policy issues as well.

Immediately after the war, French foreign policy gradually moved toward agreement with British and American diplomacy. France cooperated with the U.S., Great Britain, Belgium, the Netherlands, Luxembourg, and Canada in planning and creating an independent West German state, in planning an international authority for control of the Ruhr (q.v.), and in creating a Western defense alliance against potential Soviet aggression. France joined in the formation of the North Atlantic Treaty Organization (q.v.) on April 4, 1949, and, in spite of many difficulties arising from changes of government, remained committed to the mutual defense concept throughout the Fourth Republic.

France played a leading role in several other efforts at international cooperation during this period. The government of Premier Georges Bidault proposed, in 1950, the pooling of steel and coal resources of France, West Germany, and other western European nations under a common authority. This proposal, known as the Schuman Plan, succeeded, although the Bidault government did not remain in office long enough to achieve that success itself. The plan became a reality as the European Coal and Steel Community, created by treaty among Italy, West Germany, the Benelux (q.v.) nations, and France, in 1951. This community, in turn, gave

rise to a more ambitious plan for the economic merger of the same group of nations, which was put into effect through the Treaty of Rome in 1957 as the European Economic Community (q.v.), or Common Market.

In many respects, however, the Fourth Republic met its greatest difficulties in foreign relations. Although committed to the concept of the North Atlantic Treaty Organization (NATO), successive French governments consistently rejected the NATO military provisions, called the European Defense Community, because of the supranational character of the high military command. This led, in October, 1954, to the signing of substitute agreements (see NORTH ATLANTIC TREATY ORGANIZATION).

THE FRENCH UNION. In a bold attempt to establish a new basis of association between France and its territories around the world, the French Union was created by the constitution of 1946. It consisted of the French Republic, with its overseas departments and overseas territories, and the associated states of Morocco, Tunisia (qq.v.), and the Federation of Indochina (see INDOCHINA). It proved, however, a failure in its purpose of containing the rising nationalist sentiment of the postwar years.

Succeeding governments of the coalition "third force" repeatedly committed themselves to liquidation of a Communist-led rebellion in Indochina, which dated from 1945, and to the settlement of the costly nationalist wars in French-held regions of north Africa. Both situations seriously disrupted the internal politics of the nation repeatedly.

The Indochinese situation was settled, at least for France, through a conference convened under the auspices of the U.S., Great Britain, France, and the U.S.S.R. at Geneva, Switzerland, on April 26, 1954. Discussions on Indochina began on May 8, one day after Indochinese rebels had defeated a large force at the French stronghold of Dien Bien Phu, in northern Vietnam; see VIETNAM: *History*. Premier Joseph Laniel (1890–1975) resigned from office in June, after Communist representatives at Geneva rejected his proposal for a truce. His successor, the Radical-Socialist Party leader Pierre Mendès-France (q.v.), assumed office on June 18, promising to secure a negotiated peace by July 20 or resign. Mendès-France secured an armistice agreement on July 21. The pact, called the Geneva Agreements, provided for the surrender by France of the northern half of the Indochinese state of Vietnam to the rebels. Subsequently, South Vietnam and the Indochinese states of Laos and Cambodia declared their independence.

Also during 1954, France had begun negotiations with Tunisia on a plan to grant the Tunisian protectorate autonomy over its internal affairs. But Mendès-France failed to gain support for such North African policies, and he was forced to resign in February, 1955. Although his successor, another Radical-Socialist, Edgar Faure (1909–), promised more conservative policies, parliament ratified in August a Tunisian home-rule accord that was generally similar to the Mendès-France proposals.

After the Tunisian settlement, Algerian and Moroccan nationalists increased their demonstrations against French rule. Late in August, 1955, French troops killed some 2000 persons in the course of ending an anti-French demonstration in Algiers. The French delegation to the U.N. General Assembly was recalled, in October, after the Algerian situation had been placed on the assembly agenda for debate. France condemned the U.N. action as interference in its internal affairs.

But the Tunisian settlement had established a precedent for a more conciliatory North African policy. Support of a pro-French Moroccan sultan was withdrawn by France, and Sidi Mohammed ben Mulai Youssef (1909–61), whom the French had deposed in 1953, was restored to the throne in 1955 and ruled as King Mohammed V from 1957 to 1961.

On March 2, 1956, France and Morocco signed an agreement recognizing Morocco as an independent and sovereign state in "interdependence with France". The same status was conferred upon Tunisia on March 20. The government of the Socialist leader Guy Mollet (1905–75), who had assumed the premiership on Feb. 1, made various concessions to the Algerian nationalists. Whereas Tunisia and Morocco were protectorates, Algeria (q.v.) held the status of an overseas department of metropolitan France, and some 1,000,000 French citizens had made Algeria their home. Consequently, France was unwilling to offer independence to the Algerian nationalists. French forces were committed in large numbers to combat in Algeria, and the direct cost of the war was heavy.

A complicating factor was the French role in a brief war in Egypt, in October, 1956, following Egyptian nationalization of the Suez Canal, previously an internationally owned corporation (see EGYPT, ARAB REPUBLIC OF: *History: The Republic*). During the fighting, many ships had been sunk in the Suez Canal, blocking traffic. French support for Israel in the fighting also led Arab governments sympathetic to Egypt to cut oil pipelines, reducing the flow of petroleum to

France and most of Europe. The shortage forced the French government to ration petroleum products, which led, in December, to reduced industrial production and increased unemployment. The U.S. helped mitigate the crisis by increasing shipments of oil to Europe.

The government of Premier Mollet outlined a plan for Algerian internal autonomy within the French Union before the U.N. in February, 1957. But this plan, when coupled with economic difficulties, brought sharp attacks on the government's policies, and Mollet resigned in May. The succeeding government, led by Radical-Socialist Maurice Bourgès-Manoury (1914–), also fell, in September, because of combined opposition to his Algerian policy from conservatives and the Communists. Felix Gaillard (1919–70), also a Radical-Socialist, succeeded in organizing a new government in November and, in January, 1958, after much parliamentary maneuvering, won approval of a new law establishing the framework for governmental institutions in Algeria.

This action in no way relieved the pressures of the Algerian war, which heightened with the French aerial bombardment of the Tunisian village of Sakiet-Sidi-Youssef, on the Algerian border, on Feb. 8, 1958. In April, a combination of conservatives and Communists forced the resignation of the Gaillard cabinet. Almost one month later, Pierre Pflimlin (1907–), M.R.P. leader, succeeded in organizing a new government. But on the same day, May 13, a group of French military and civilian leaders in Algeria formed the Committee of Public Safety for the avowed purpose of bringing General Charles de Gaulle back to power. The committee feared the Pflimlin government would negotiate a settlement that might eventually lead to Algerian independence, which the committee leaders opposed. On May 27, after two weeks of political maneuvers, de Gaulle announced that he had begun the "process necessary for the establishment of a republican government . . .". Pflimlin resigned, at the request of President René Coty, the next day. Coty then went before the National Assembly to urge that de Gaulle be named premier to avert civil war.

The strongest opposition to de Gaulle was expressed by the Communists, who called for a general strike on May 30. They were successful in promoting only sporadic work stoppages. On June 1, the National Assembly approved de Gaulle as premier, granted him the right to rule by decree for six months, and, on June 2, recessed. De Gaulle formed a cabinet of members of seven political parties, and promised that he



President Charles de Gaulle, addressing a press conference at the Élysée Palace in Paris in 1968, condemns the Soviet invasion of Czechoslovakia. UPI

would prepare a new constitution providing for a strong executive. Thus the stormy Fourth Republic ended.

The Fifth Republic. The proposed constitution of the Fifth French Republic was adopted by referendum on Sept. 28, 1958, and promulgated formally on Oct. 4 (see *Government*, above). Despite left-wing opposition, 79 percent of the vote cast in France was favorable. The referendum was affirmative also in all other entities of the French Union except French Guinea. By rejecting the referendum, French Guinea automatically became completely independent, under the name Guinea (see *GUINEA, REPUBLIC OF*). By virtue of the constitution, the other Union entities and France were associated in the Community.

The electoral college, which on Dec. 21 chose the first president of the Fifth Republic, cast more than 75 percent of its votes for de Gaulle. After his installation on Jan. 8, 1959, de Gaulle named Michel Debré (1912–) premier. Debré's cabinet received a vote of confidence from the National Assembly of 453 to 56, with 29 abstentions. De Gaulle was the initiator of French policy. He insisted that France would withhold from NATO the power to control the French navy, and he suggested that a revived

France might fruitfully mediate between the U.S. and the U.S.S.R.

De Gaulle determined on a policy that would permit the Algerian population to choose its own fate; see *ALGERIA: History*. Disorders among Europeans in Algeria broke out in January, 1960, but were quickly terminated. A year later, citizens in both Algeria and France were asked to vote on the establishment of a public authority in Algeria, prior to Algerian self-determination. The proposal was supported by a strong majority in the elections, which were boycotted by 26 percent of the French electorate and about 43 percent of the Algerian voters. As a result, however, measures were taken to grant provisional autonomy to Algeria. Terrorist outbreaks, led by anti-Gaullist French Army officers in a secret organization (O.A.S.), occurred in March and April. De Gaulle met the emergency by assuming power to rule by decree, which he retained until the end of September. The main force of the terrorist revolt was crushed in April, but sporadic incidents of terrorism occurred afterward.

In March, 1962, an agreement was reached between France and the Algerian rebels, ending eight bitter years of war, and leading to a referendum, in July, in which Algeria overwhelmingly chose independence from, and cooperation with, France.

In May, 1962, five cabinet ministers resigned in protest against policies of de Gaulle, particularly his opposition to full-scale European political integration. Such integration was the long-term objective of the European Economic Community (q.v.), or E.E.C. of which France was a founding member in 1957; see also *EUROPEAN COMMUNITIES*. Later that same year parliament was antagonized when de Gaulle, disregarding constitutional requirements, bypassed it in pressing for reform of the constitution to provide for popular election of French presidents. The cabinet, censured by the National Assembly for its approval of the proposal for a referendum on the issue, resigned on Oct. 6, and de Gaulle dissolved the Assembly on Oct. 10. In the referendum held on Oct. 28, the proposal was supported by 62 percent of the voters.

In its foreign relations, the Fifth Republic, under the strong leadership of de Gaulle, was noted for its relatively independent course. De Gaulle began developing an independent French nuclear force in mid-1963 and, refusing to make France a signatory of the nuclear test-ban treaty of 1963, used Algerian portions of the Sahara (q.v.) as a testing ground. Throughout the 1960's, de Gaulle alone seems to have op-

posed Great Britain's entry into the European Economic Community, arguing that such a course would lead to an Atlantic community totally dependent upon U.S. leadership. Under de Gaulle France sought a renewal of more or less traditional friendly relations with the East, in the form of improved trade conditions with the Soviet Union, the establishment of diplomatic relations with Communist China, and disruption of what he appeared to believe was an American hegemony over the future of Europe. In mid-1966, de Gaulle announced the withdrawal of all French forces from the NATO command and, in addition, ordered the removal from France of all foreign military forces not under French command, including the NATO military headquarters in Paris.

The stability that characterized the government of the Fifth Republic, in marked contrast with government in the Fourth Republic, had effects on the economy, as well as on the diplomatic and political aspects of French life. The gross national product of France increased steadily during the 1960's, as did production of such important industries as those in the automotive, aircraft, household-appliance, machinery, chemical, and electronics fields. De Gaulle consistently displayed a concern with growing U.S. power in the form of partial American ownership of French industries. Partly to prevent American acquisition of French firms, the French government instituted a program, in the 1960's, of acquiring partial ownership of those firms itself. Of the two major automotive pro-

ducers, Renault was nationalized and Peugeot became partly owned by the government.

In May, 1968, France was confronted with a series of upheavals that nearly wrecked the economy. Student demonstrations protesting the political and educational systems led to clashes with the police in ten days of street fighting. Workers then joined the students, and the wave of strikes that followed virtually paralyzed industry, commerce, communications, and transportation. In order to meet the crisis de Gaulle dissolved the National Assembly and called for national elections, in which the Gaullist party and its allies won an overwhelming majority. After the election, Premier Pompidou offered his routine resignation; to the amazement of most observers, President de Gaulle accepted it and replaced him with Maurice Couve de Murville (1907-). President de Gaulle resigned his office in April, 1969, after his proposals for administrative and legislative reforms were rejected in a national referendum. He lived thereafter in retirement until his death in 1970.

France After de Gaulle. Following an interim presidency, former Premier Georges Pompidou (q.v.) was elected in June as the second president of the Fifth Republic. He chose as premier Jacques Chaban-Delmas (1915-), who for eleven years had served as president of the National Assembly. The first major action taken by

At the outset of a tour of the U.S. in 1976, French President Valéry Giscard d'Estaing and his wife board the helicopter Marine One at Andrews Air Force Base for their flight to the White House.

Wide World



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the new government was to devalue the franc by 12.5 percent. Otherwise, Pompidou's policies did not depart significantly from lines laid down by his predecessor.

In the area of international relations, Pompidou tried to establish better relations with the U.S. on the Middle East problem; nonetheless, he agreed to sell 110 mirage jet aircraft to Libya early in 1970. He was unequivocal in seeking closer French ties with Great Britain. This rapprochement was evidenced by continued cooperation with the English on the joint program to build a supersonic transport (the Concorde) and by receptivity toward Great Britain's entry into the Common Market. Pompidou met in February, 1972, with Chancellor Willy Brandt (q.v.) of West Germany and reached agreement to press jointly for greater political cooperation and economic and monetary union among members of the E.E.C. Pompidou campaigned strongly for French agreement to enlarge the E.E.C., and the electorate gave its approval in a referendum held in April, 1972. In July Premier Chaban-Delmas was succeeded by Pierre Messmer (1916-). In elections to the National Assembly in March, 1973, the Gaullist coalition won an absolute majority.

Pompidou died on April 2, 1974. In May, Valéry Giscard d'Estaing (q.v.), a moderate former finance minister who represented the Gaullists, was elected as the new president when he defeated François Mitterrand (1916-), leader of the Socialist Party, in an extremely close contest. Describing himself as a "traditionalist who loves change", Giscard brought several new faces into the cabinet, which was headed by Jacques Chirac (1932-). The president promised to try to modernize French society, and in 1974 several reforms were approved by parliament. These included measures liberalizing the laws on abortion and lowering the voting age from 21 to 18. In foreign affairs, Giscard pursued a conciliatory policy emphasizing close ties with the other Common Market countries, the U.S., and former French African possessions.

During the following years France underwent considerable internal ferment. A lagging economy, characterized by high rates of inflation and unemployment (especially among younger workers), provoked several mass demonstrations by organized labor. The economic problems also were a major reason for the resignation, in mid-1976, of Premier Chirac, who was replaced by Raymond Barre (1924-), a nonpartisan expert on economics. In late 1976 Chirac formed a new Gaullist party, the Rassemblement pour la République (see *Political Parties*, above), which

quickly gained a large following. He was elected mayor of Paris in 1977, when the office was restored after a lapse of 106 years.

In the mid-1970's many Frenchmen became increasingly concerned with the effects of industry and technology on the environment. Their worries were confirmed in early 1978, when great quantities of crude oil escaped from a supertanker, the *Amoco Cadiz*, which had run aground and broken apart in the English Channel. This huge oil spill polluted the coastal waters and beaches of much of Brittany. Also causing apprehension among the French was a growing separatist movement on Corsica.

After making significant gains in departmental elections in 1976 and in municipal elections in 1977, the country's leftist political parties appeared ready to win control of the National Assembly in elections set for March, 1978. In January, 1978, however, the crucial electoral alliance between the Socialists and the Communists collapsed, largely because of disagreements over economic policy. An attempt was quickly made to repair relations, but the Left had by then alienated many supporters, and in the election, candidates backing Giscard's government won 291 of 491 seats in the National Assembly.

FRANCE, Anatole, pen name of JACQUES ANATOLE FRANÇOIS THIBAUT (1844-1924), French novelist, born in Paris. He attended the Stanislas School in Paris, but was mostly self-educated. From early youth he was an insatiable reader. His first published books were the volume of verse *Les Poèmes Dorés* ("Golden Tales", 1873) and the verse drama *Les Noces Corinthiennes* (1876; Eng. trans., *The Bride of Corinth*, 1920). It was not, however, until the publication of his first novel, *Le Crime de Sylvestre Bonnard* (1881; Eng. trans., *The Crime of Sylvestre Bonnard*, 1906), that he exhibited the stylistic grace, subtle, biting irony, and genuine compassion that later became the distinguishing characteristics of his work. He produced a large body of writings, including novels, drama, verse, critical and philosophical essays, and historical works, and was generally regarded as the greatest French writer of his time. He was awarded the 1921 Nobel Prize in literature and became a member of the French Academy in 1896.

In 1883 France met Madame Arman de Caillavet (d. 1910), a prominent Parisian with whom he formed a long liaison. Mme. de Caillavet inspired France to arduous creative labors and promoted his works through her social connections. His writings of those middle years include the volumes of critical essays *La Vie Littéraire* ("The Literary Life", 4 vol., 1888-92); the novels

Thaïs (1890; Eng. trans., 1909) and *Le Lys Rouge* (1894; Eng. trans., *The Red Lily*, 1908); and the tetralogy of novels *L'Histoire Contemporaine* ("A Contemporary Tale", 1897–1901), a harsh analysis of the corrosive effects on French life of the Dreyfus affair (q.v.). France was among the French intellectuals who, under the leadership of the novelist Émile Zola (q.v.), fought successfully for the exoneration of Alfred Dreyfus, a captain in the French army, convicted of treason.

Later Writings. In his later works, France became an advocate of humanitarian causes. He made eloquent pleas in his writings for civil liberties, popular education, and the rights of labor, and attacked with bitter, brilliant satire the political, economic, and social abuses of his time. Despite his polemics, however, the elegant, sweeping cadences and masterly language of France's works testified to his devotion to classical forms. Outstanding among the writings that demonstrate both his powerful social consciousness and his classical eloquence are the allegorical novels *L'Île des Pingouins* (1908; Eng. trans., *Penguin Island*, 1909) and *La Révolte des Anges* (1914; Eng. trans., *The Revolt of the Angels*, 1914), and an account of the Reign of Terror during the French Revolution (q.v.), *Les Dieux Ont Soif* (1912; Eng. trans., *The Gods Are Athirst*, 1913).

France is also the author of the scholarly biography *Vie de Jeanne d'Arc* (1908; Eng. trans., *The Life of Joan of Arc*, 1909), a work that was greatly influenced by the rationalistic, skeptical approach of the French religious historian (Joseph) Ernest Renan (q.v.).

FRANCE, ÎLE DE, former name of the island of Mauritius (q.v.).

FRANCE, INSTITUTE OF. See INSTITUTE OF FRANCE.

FRANCESCA, Piero della. See PIERO DELLA FRANCESCA.

FRANCESCA DA RIMINI (d. 1285?), Italian noblewoman, daughter of Guido da Polenta (ruled Ravenna, 1275–90), probably born in Ravenna. Most likely because of paternal political considerations of her father, Francesca became the wife of Giovanni Malatesta da Rimini (d. 1304), who was allegedly very unattractive. She was drawn to Giovanni's younger brother Paolo Malatesta da Rimini (d. 1285?), who became her lover. When her husband discovered the relationship, he murdered the couple. This tragic love affair provides the theme of one of the most famous episodes of *The Divine Comedy* (q.v.) by the Italian poet Dante Alighieri (q.v.), in which Paolo and Francesca are depicted with great compassion.

The story has inspired other works of literature, including the poem *Story of Rimini* (1816), by the British author Leigh Hunt (q.v.), and the drama *Francesca da Rimini* (1902), by the Italian writer Gabriele D'Annunzio (q.v.). The story of Francesca has also been the subject of works by the 19th-century French painters Jean Auguste Dominique Ingres (q.v.) and Alexandre Cabanel (1823–89), and of the orchestral fantasy "Francesca da Rimini" (1876) by the Russian composer Pëtr Ilich Tchaikovsky (q.v.).

FRANCHET D'ESPEREY, Louis Félix Marie Francois (1856–1942), French army officer, born in Mostaganem, Algeria, and educated at Saint Cyr Military Academy. He joined the infantry in 1876 and served in Africa and Asia, becoming general of a brigade in 1908 and general of a division in 1912. On the outbreak of World War I he became commander of the first French army on the Meuse R. in France and later in 1914 was appointed commander of the fifth French army, which he led at the Battle of the Marne (see MARNE, BATTLE OF THE: *First Battle of the Marne*). In 1916–17 he was successively in command of the eastern and northern groups of armies in France. In 1918 he commanded the Allied army that defeated the Germans and Bulgarians on the Vardar R. in the Balkans, precipitating the surrender of Bulgaria. He next drove the Austrians out of Serbia (now in Yugoslavia). After an additional period in the Balkans, he commanded the Allied armies in Turkey until 1920. D'Esperey was given the title of marshal in 1921, and in 1934 he became a member of the French Academy.

FRANCIA, José Gaspar Rodríguez 1761?–1840), Paraguayan dictator known as Dr. Francia, born in Asunción, and educated at the University of Córdoba, Argentina. After studying law, he maintained a legal practice in Asunción. When Paraguay gained its independence from Spain in 1811, he was appointed to the junta, or administrative council. In 1814 he was made dictator of Paraguay for three years and in 1817 was chosen dictator for life. Although Francia's rule was tyrannical, he established a number of republican reforms and fostered new developments in industry, trade, and agriculture. See PARAGUAY.

FRANCIS, Saint. See FRANCIS OF ASSISI, SAINT.

FRANCIS, name of several European emperors and kings. Brief accounts of less important rulers are included in this article under the names of the countries which they ruled. The more important monarchs are described in separate biographical sketches, to which the reader is referred below.

FRANCIS (Austria)

The English name *Francis* appears in French as *François*, in German as *Franz*, and in Italian as *Francesco*.

AUSTRIA

Francis I (1768–1835). See FRANCIS II, Holy Roman Emperor.

FRANCE

Francis I (1494–1547). See FRANCIS I, King of France.

Francis II (1544–60). See FRANCIS II, King of France.

HOLY ROMAN EMPIRE

Francis I (1708–65). See FRANCIS I, Holy Roman Emperor.

Francis II (1768–1835). See FRANCIS II, Holy Roman Emperor.

THE TWO SICILIES

Francis I (1777–1830), King of the Two Sicilies (1825–30), the son of Ferdinand I (q.v.), King of the Two Sicilies. Francis was viceroy of Sicily from 1812 to 1816 and duke of Calabria from 1817 to 1825. In the former post he granted the Sicilians a constitution, which Ferdinand I suppressed on his restoration (1816) to the throne.

Francis II (1836–94), King of Naples (1859–61). Son of Ferdinand II (q.v.), King of the Two Sicilies, and grandson of Francis I, he was the last Bourbon ruler of the Two Sicilies. He tried to execute the autocratic policies of his father, but his kingdom was lost in the unification of Italy. In 1860 the country was invaded by revolutionary troops under the Italian nationalist leader Giuseppe Garibaldi (q.v.); the kingdom was forced to capitulate the following year. Compelled to abdicate in 1861, Francis lived thereafter in various European countries, from which he occasionally organized abortive conspiracies against the new Kingdom of Italy.

FRANCIS I (1494–1547), King of France (1515–47), son of Charles, Count of Angoulême (d. 1496) and Louise of Savoy (1476–1531), born in Cognac. In 1514 Francis was married to Claude de France (1499–1524), daughter of Louis XII (q.v.), King of France, whom Francis succeeded. By his victory in that same year at Marignano in northern Italy, Francis acquired Lombardy. Because he was an aspirant to the crown of the Holy Roman Empire, he was embittered by the election in 1519 of Charles I, King of Spain as Charles V (q.v.), Holy Roman Emperor. The jealousy of Francis resulted in twenty-five years of intermittent warfare with the emperor. Although the interview between Francis and Henry VIII (q.v.), King of England, on the Field of the Cloth of Gold (q.v.) in 1520 did not produce an alliance, Francis declared war on Charles V in 1521 and subsequently suffered a

series of reverses, including the desertion to the imperial cause in 1523 of the constable Duc Charles de Bourbon (q.v.), one of the most powerful French nobles. During the French defeat at Pavia in 1525, Francis was captured. He was imprisoned at Madrid, lost his rights in Italy, and was forced to cede to Charles V, and to renounce his suzerainty over Artois and Flanders. War was renewed in 1527, when Henry VIII joined forces with the emperor, and all of Italy, led by Pope Clement VII (see under CLEMENT), allied itself with France. The war proved generally unsuccessful for France, and a peace treaty of 1529 confirmed all of the losses of 1526 except that of Burgundy, which was restored to France. In 1536 Francis began a final series of wars against Charles V. He defeated Charles and



A portrait of Francis I, King of France, by the 16th-century Flemish artist Joos van Cleve.

Metropolitan Museum of Art – Michael Friedsam Collection

Henry VIII, with whom the emperor had made an alliance in 1542, at Ceresole Alba in 1544. In that same year France was invaded by imperial troops, and a peace, confirming the earlier loss of Artois and Flanders, was signed at Cr cy-en-Valois. Two years later peace was established between France and England by the Treaty of Ardres.

Francis effectively created an absolute monarchy during his reign by destroying the power of his last rival feudal noble, the Constable de Bourbon, and by centralizing finances and administration. Nobles became mere household officials, and control of the clergy was accomplished by the Concordat of 1516 with Pope Leo

X (see under LEO). A noted humanist (see HUMANISM), Francis laid the foundations of the Collège de France by appointing scholars to teach humanistic subjects. Before 1534 he was influenced by his sister, Margaret of Navarre (q.v.), in according the Protestants leniency. After various violent demonstrations on the part of the Reformers, however, he turned against the Protestant movement, authorizing such acts of repression as the massacre of the Waldenses (q.v.) in 1545. He was a noted patron of Renaissance art, and invited to his court the Italian artists Andrea del Sarto, Benvenuto Cellini, and Leonardo da Vinci (qq.v.) and encouraged the building of the châteaux at Chambord and Fontainebleau.

FRANCIS II (1544–60), King of France (1559–60), born in Fontainebleau, the eldest son of Henry II (see under HENRY: France). In 1558 Francis married Mary, Queen of Scots (q.v.). Francis was a mental and physical weakling and was dominated by François, Duke of Guise, and Charles, Cardinal of Lorraine, the uncles of his wife; see under GUISE. These two men, who in effect were the rulers during the brief reign of Francis, tried to repress the growing political power of the Protestants in France.

FRANCIS I, originally FRANCIS STEPHEN (1708–65), Holy Roman Emperor (1745–65), born in Nancy, France, and educated in Vienna. The son of Leopold, Duke of Lorraine (r. 1697–1729), Francis succeeded his father in 1729, but ceded Lorraine in 1737 to Stanislas I Leszczyński (q.v.), King of Poland, in exchange for the Grand Duchy of Tuscany. Francis married Maria Theresa (q.v.), Archduchess of Austria, in 1736 and with her ruled the Hapsburg (q.v.) hereditary dominions from 1740 to 1745. In the latter year and through the influence of his wife he became Holy Roman Emperor. Francis did not participate in the wars, from 1740 to 1748, of Frederick II, King of Prussia, against Maria Theresa (qq.v.), Archduchess of Austria, or in the Seven Years' War (q.v.).

FRANCIS II (1768–1835), last Holy Roman Emperor (1792–1806) and, as Francis I, first Emperor of Austria (1804–35), born in Florence, Italy, and educated in Vienna. He succeeded his father Leopold II (q.v.) as Holy Roman Emperor. From the start of his reign until 1815 Francis was involved in the wars of the French Revolution and in the Napoleonic Wars (qq.v.). Aware that the Holy Roman Empire could not survive the military and political upheavals of his time, Francis consolidated his power in Austria, Hungary, Bohemia, and northern Italy and proclaimed himself emperor of Austria in 1804. Two years later he formally dissolved the old Holy Roman Em-

pire. As emperor of Austria, Francis gave Prince Klemens von Metternich (q.v.) almost complete control of foreign affairs after 1809 and devoted himself to the internal administration of the empire. The marriage of his daughter Marie Louise (1791–1847) to Napoleon I (q.v.), Emperor of France, in 1810 earned for Francis three peaceful years in which to recreate Austrian strength for participation in the campaign that brought Napoleon's downfall in 1814–15 (see HOLY ALLIANCE). By the decisions of the Congress of Vienna in 1815, Francis recovered most of the territory Austria had lost to Napoleon. The last twenty years of his reign were marked by paternalistic measures, reactionary tendencies, and repression of liberalism.

FRANCISCANS, officially the **ORDER OF FRIARS MINOR**, religious order (see ORDERS, RELIGIOUS), founded, probably in 1207, by Saint Francis of Assisi (q.v.) and approved by Pope Innocent III (see under INNOCENT) in 1209. When Francis obeyed the call to devote himself to a life of preaching, service, and poverty, he soon gathered around him a band of twelve disciples. Francis led them from Assisi to Rome to ask for the blessing of the pope, who expressed doubt about the practicability of the way of life that the group proposed to adopt. Pope Innocent gave them his blessing, however, on condition that they become clerics and elect a superior. Francis was elected superior and the group returned to Assisi, where they obtained from the Benedictine abbey (see BENEDICTINES) on Mt. Subasio the use of the little chapel of Santa Maria degli Angeli, around which they constructed huts of branches. Then in imitation of Christ, they began a life of itinerant preaching and voluntary poverty.

At this time the brotherhood lacked formal organization and a novitiate, but as the disciples increased and their teaching spread, it became obvious that the personal example of Francis would not suffice to enforce discipline among the friars. In 1223 Pope Honorius III (d. 1227) issued a bull that constituted the Friars Minor a formal order and instituted a one-year novitiate.

Following the death of Francis in 1226, the convent and basilica at Assisi were built. Their magnificence disturbed some, who believed it incommensurate with Francis' ideals of poverty. After much dissension, Pope Gregory IX (1147?–1241) decreed that monies could be held by elected trustees of the order and that the building of convents was not contrary to the intentions of the founder.

As time passed, the order grew, the only body of equal power being the Dominicans (q.v.).

FRANCISCANS

The Franciscans, however, became fractionalized and in 1517 Pope Leo X (see *under* LEO) divided the order into two bodies, the Conventuals, who were allowed corporate property, as were other monastic orders, and the Observants, who sought to follow the precepts of Francis as closely as possible. The Observants have ever since been the larger branch, and early in the 16th century, a third body, the Capuchins (q.v.), was organized out of it and made independent. At the end of the 19th century Leo XIII (see *under* LEO) grouped these three bodies together as the First Order of Friars Minor, designating the Poor Clares (see CLARE OF ASSISI, SAINT), nuns, as the Second Order, and the Tertiaries, men and women living in secular society without celibacy (q.v.), as the Third Order.

In addition to their preaching and charitable work, the Franciscans have been noted for their devotion to learning. Before the Reformation in England (see REFORMATION: *England*) they held many positions in the universities, prominent among the professors being John Duns Scotus, William of Ockham, and Roger Bacon (qq.v.). Five popes have been Franciscans: Alexander V (1340–1410), Sixtus IV (see *under* SIXTUS), Julius II (q.v.), Sixtus V (see *under* SIXTUS), and Clement XIV (see *under* CLEMENT).

On his first voyage of discovery to America, Christopher Columbus (q.v.), the Italian navigator, was accompanied by a group of Franciscans. The first convents in America were established by them, at Santo Domingo and La Vega in what is now the Dominican Republic. The rapid conversion of the Indians and the consequent enthusiasm of the missionary-minded in Spain led to the further spread of the order in the West Indies; before 1505, Ferdinand V (q.v.), King of Castile, known as the Catholic, found it necessary to issue a decree that new convents should be placed at least five leagues apart. While the Spanish Franciscans gradually spread through the southern part of the New World as far as the Pacific Ocean, the French friars, who had arrived in Canada in 1615, at the behest of the French explorer Samuel de Champlain (q.v.) set up missions throughout the north. Today the Franciscans conduct a university and five colleges in the United States, and a seminary, in Allegany, N.Y. They also engage in regular parish work, as well as mission work among the Indians.

The supreme government of the order is vested in an elective general, resident at the General Motherhouse, in Rome. Subordinate are the "provincials", who preside over all the brethren in a province, and the *custodes*, or

"guardians" (never called "abbots", as are their opposite numbers in other orders), at the head of a single community or convent. These officers are elected for a period of two years. The Franciscan Order, by virtue of this elective principle, is the embodiment of the democratic element in the Roman Catholic Church. See MENDICANT FRIARS; MONASTIC ART.

In the early 20th century a number of Franciscan communities for both men and women were established by various Anglican churches. The most prominent of these is the Society of Saint Francis in Cerne Abbas, Dorset, England, which maintains several houses in the British Isles and in New Guinea. In 1967 a similar group in the U.S. was united with these English friars. **FRANCIS FERDINAND** (Ger. *Franz Ferdinand*) (1863–1914), Archduke of Austria, born in Graz, son of Archduke Charles Louis (1833–96) and nephew of Francis Joseph (q.v.), Emperor of Austria. In 1875 he inherited the title Archduke of Austria-Este. After the deaths of his cousin Crown Prince Rudolf (q.v.) in 1889 and of his father in 1896, Francis became heir to the Austro-Hungarian crown. Because of his morganatic marriage in 1900 to Countess Sophie Chotek, Duchess of Hohenberg (1868–1914), Francis relinquished all claim to the throne for his children. He and his wife were assassinated in Sarajevo, Bosnia, on June 28, 1914, by Serbian nationalists. The incident precipitated World War I (q.v.).

FRANCIS JOSEPH I, or (Ger. *Franz Josef*) (1830–1916), Emperor of Austria (1848–1916), and King of Hungary (1867–1916), born in Schönbrunn. He became emperor when his father, the brother and heir of Ferdinand I, Emperor of Austria (see *under* FERDINAND), renounced any claim to the throne, which had been abdicated by Ferdinand after the Austrian revolution of 1848. The first eighteen years of the reign of Francis Joseph were characterized by strict absolutism and repression of liberal political movements. In 1849 his forces quelled the uprisings in Austrian dominions in Italy and suppressed a revolt in Hungary. In 1851 he abrogated the Austrian constitution that had been granted two years earlier, and in 1855 he made a concordat with the Vatican, giving the clergy jurisdiction over education and according the Church greater powers over marriage laws. In 1859, during the Italian War of Liberation, Austria lost all Italian possessions except Venetia, which was retained, however, only until 1866. Following defeat by Prussia in the Seven Weeks' War (q.v.) of 1866, Austria was compelled to withdraw from the German Confederation, after



"Saint Francis Speaking to the Birds" (from an illuminated manuscript of the 13th century). Pierpont Morgan Library

which the traditional Austrian leadership of German states passed to Prussia. In the following year the Ausgleich of 1867 (q.v.) was drawn up, making Hungary, which had been a crown-land of Austria, a separate kingdom with the same status as Austria; the two countries were united as equal partners in the Austro-Hungarian Empire under a single Hapsburg (q.v.) monarch. At the same time Francis Joseph agreed to constitutional reforms that limited his autocratic power.

Austria-Hungary, under Francis Joseph, joined Germany and Italy in the so-called Triple Alliance of 1882. After the deaths of Rudolf (q.v.), the only son of the emperor, in 1889, and of Charles Louis (1833–96), the younger brother of the emperor in 1896, the Archduke Francis Ferdinand (q.v.), a nephew of Francis Joseph, was made heir to the throne. The assassination in 1914 of Francis Ferdinand in Sarajevo (q.v.) precipitated World War I (q.v.), in which Francis Joseph supported his ally William II (q.v.), Emperor of Germany. Francis Joseph was succeeded as emperor of Austria by his grand-nephew, Charles I (q.v.). Two years later the Central Powers (q.v.) were defeated, resulting in the breakup of the Austro-Hungarian Empire.

See AUSTRIA-HUNGARY.

FRANCIS OF ASSISI, Saint, originally GIOVANNI FRANCESCO BERNARDONE (1182–1226), Italian monk and preacher, founder of the Franciscans (q.v.), born in Assisi. Although his father was a wealthy merchant, Francis appears to have received little formal education; as a young man, he was known for his leadership in revelry. Following a battle between Assisi and Perugia, he was held captive in Perugia for over a year. While imprisoned, he suffered a severe illness, during which he resolved to alter his way of life. Back in Assisi in 1202, he performed charities among the lepers and began working upon the restoration of dilapidated churches. Francis' change of character and his expenditures for charity angered his father, who legally disinherited him. Francis then discarded his rich garments and, having obtained a cloak from the bishop, devoted the next three years to the care of outcasts and lepers in the woods of Mt. Subasio.

For his devotions on Mt. Subasio, he restored the ruined chapel of Santa Maria degli Angeli. In 1209, one day during Mass, he heard a call telling him to go out into the world and, according to the text of Matt. 10:5–14, to possess nothing, but to do good everywhere.

Upon returning to Assisi that same year, Francis began preaching to the people. He gathered round him the twelve disciples who became the original brothers in his order, the First Order; they elected Francis superior. In 1212 he received a young, well-born nun of Assisi, Clare (see CLARE OF ASSISI, SAINT), into Franciscan fellowship; through her was then established the Order of the Poor Ladies (the "Poor Clares"), the Second Order of Franciscans. It was probably later in 1212 that Francis set out for the Holy Land, but shipwreck forced him to return. Other difficulties prevented his accomplishing much missionary work when he went to Spain to preach to the Moors. In 1219 he was in Egypt, where he succeeded in preaching to, but not in converting, the sultan. Francis then went on to the Holy Land, staying there until 1220. He wished to be martyred and rejoiced upon hearing that five Franciscan friars had been killed in Morocco while carrying out their duties. On his return home he found dissension in the ranks of the friars and he resigned as superior, spending the next few years in planning of the Third Order of Franciscans, the tertiaries.

In September, 1224, after forty days of fasting, Francis was praying upon Monte Alverno when he felt pain mingled with joy, and the marks of the crucifixion of Christ, the stigmata (q.v.), appeared upon his body. Accounts of the appear-

FRANCIS OF PAOLA

ance of these marks differ, but it seems probable that they were knobby protuberances of the flesh, resembling the heads of nails. Francis was carried back to Assisi, where his remaining years were marked by physical pain and almost total blindness. He was canonized by Pope Gregory IX (r. 1227–41) in 1228. In art, the emblems of Saint Francis are the wolf, the lamb, the fish, birds, which he loved and the stigmata. His feast day is Oct. 4.

T.M.H.

FRANCIS OF PAOLA, Saint or **FRANCIS OF PAULA, Saint** (1416–1507), Italian monk, founder of the Order of Minims (see **ORDERS, RELIGIOUS**), born in Paola, in Calabria. He became a hermit in early youth, but attracted a following of disciples. This group adopted ascetic practices that exceeded in severity even those of the Franciscans (q.v.). Comparing themselves to the Franciscans, known as Friars Minor (Lat. *minor*, “less”), they called themselves Minims (Lat. *minimus*, “least”). The Order of Minims, founded in 1436, received formal confirmation from Pope Sixtus IV (see *under* SIXTUS) in 1474. Francis attended Louis XI (q.v.), King of France, at his death (1483) and was adviser to the two succeeding kings of France, Charles VIII (see *under* CHARLES) and Louis XII (q.v.). He was canonized in 1519; his feast day is April 2.

FRANCIS OF SALES, Saint (Fr. *François de Sales de Boisy*) (1567–1622), French Roman Catholic prelate and writer, born in Thorens, of a noble Savoyard family, and educated at the Jesuit College of Clermont in Paris and at the University of Padua. He received the degree of doctor of laws at the latter institution in 1591, and was ordained a priest two years later. In 1594 he was sent to Chablais, a former region in the Duchy of Savoy, to convert the Calvinists; see **CALVINISM**. In 1602 he was appointed Bishop of Geneva. In 1610 he helped found the Order of the Visitation of Our Lady specifically for persons debarred by physical handicaps from entry into other orders. Francis is chiefly remembered, however, for his insistence, contrary to the popular belief of his time, that it is possible for an ordinary person to lead a wholly pious and saintly life while remaining in worldly society, instead of withdrawing into a monastic order. He was canonized in 1665, and in 1877 Pope Pius IX (see *under* PIUS) declared him a doctor of the Church. Since 1922 he has been regarded as the patron saint of Roman Catholic writers. His works include *Introduction to the Devout Life* and *Treatise on the Love of God*. His feast day is Jan. 29.

FRANCIS XAVIER, Saint. See **XAVIER, SAINT FRANCIS**; **JESUITS**.

FRANCIUM or **ACTINIUM K**, element with at.no. 87, at.wt. 223, and symbol Fr. Marguerite Perey of the Curie Laboratory of the Radium Institute of Paris discovered this element in 1939 and studied its physical and chemical properties.

Actinium disintegrates by emission of beta rays into radioactinium and by emission of alpha rays into francium; only 12 actinium atoms in 1000 disintegrate in the latter manner. Francium is naturally radioactive, with a half-life of 21 min. It emits a beta ray of 1,200,000 electron volts (ev) energy and a gamma ray of 95,000 ev energy.

Francium is the heaviest of the alkali elements and closely resembles cesium (q.v.) in its chemical properties. It is the most electropositive of all the elements. All its isotopes are radioactive and short-lived; they have been studied only by tracer chemistry and have no practical applications.

FRANCK, César Auguste (1822–90), Belgian-born French composer and organist, born in Liège. A precocious musician, he made a piano concert tour of Belgium at the age of eleven. He studied music in Liège and, from 1837 to 1842, at the Paris Conservatory, at which he revealed great ability as an organist and composer. From 1844 he taught music privately in Paris. In 1872 he became professor of the organ at the conservatory and from 1858 to 1890 he was organist

César Auguste Franck



at the Church of Sainte Clotilde, Paris. Among his pupils at the conservatory were the French composers Vincent d'Indy and Ernest Chausson (q.v.). Franck became a naturalized French citizen in 1873.

Franck's work is characterized by the use of classical forms, including the symphony and sonata, which he imbued with a romantic spirit. He alternates between themes of a mystical and brooding nature and those of a dramatic and emotional type. He was one of the outstanding practitioners of the modern cyclical form, in which themes recur in modified form throughout a work.

Although Franck's work was neglected during his lifetime, his compositions are now part of the standard repertory of instrumentalists and orchestras. His Symphony in D minor (1886-88) ranks among the most popular of all symphonies and has served as the model for many important French symphonic works.

Among Franck's other compositions are the oratorio *Les Béatitudes* (1869-79); orchestral works, including three symphonic poems; *Variations Symphoniques* for piano and orchestra (1885); the Sonata for Piano and Violin (1886); and organ works, including *Six Pièces pour Grand Orgue* ("Six Pieces for the Great Organ", 1860-62) and *Trois Chorals* (1890).

FRANCK, James (1882-1964), German-American physicist and chemist, born in Hamburg, Germany, and educated at the universities of Heidelberg and Berlin. From 1918 to 1920 he was chairman of the department of physics at the Kaiser Wilhelm Institute in Berlin and, from 1920 to 1933, professor and director of the Physical Institute at the University of Göttingen. After arriving in the United States in 1935, Franck was professor of physics at Johns Hopkins University. Three years later he was appointed professor of physical chemistry at the University of Chicago, of which he became professor emeritus in 1947. Meanwhile he became a U.S. citizen. After 1949 he served as director of the photosynthesis project at the Research Institutes of the University of Chicago. He also served as visiting professor at several other American universities.

In collaboration with the German physicist Gustav Hertz (q.v.), Franck conducted notable experiments on the effects produced by bombarding atoms with electrons. For that research, which provided experimental verification of the quantum theory (q.v.), he shared the 1925 Nobel Prize in physics with Hertz. Franck is also noted for his important contributions to the study of photosynthesis (q.v.), the process by which

green plants make use of radiant energy to convert carbon dioxide and water into carbohydrates.

FRANCO, Francisco, in full FRANCISCO PAULINO HERMENEGILDO TEODULO FRANCO Y BAHAMONDE (1892-1975), Spanish dictator, born in El Ferrol (now El Ferrol del Caudillo). In 1910 he was graduated from the infantry school at Toledo, and during the next twenty-one years he held a variety of military assignments, primarily in what was then Spanish Morocco. He was commander in chief of the Spanish Foreign Legion from 1923 to 1927, was credited with the defeat of the Riff leader Abdel-Krim (q.v.) in 1926, then studied at Saint-Cyr military school, Paris, and was director of the military academy at Saragossa from 1927 to 1931. In 1931, upon the establishment of the second Spanish republic, Franco, suspected of monarchist sympathies, was appointed captain general of the Balearic Islands, an assignment representing virtual exile. With the return of the rightist faction to power in Madrid two years later, Franco returned to the mainland and in 1935 was appointed chief of the army general staff. When the republican Popular Front won the general elections in 1936, Franco was again "exiled", as military governor of the Canary Islands. Later that year Franco took a leading hand in the revolt against the republican government; he flew to Morocco and assembled a large force which he led to Spain.

The Civil War. In October, 1936, shortly after the outbreak of the Spanish Civil War, he was proclaimed head of the insurgent government and commander in chief (generalissimo) of the army. The insurgent force gained both diplomatic recognition as the legal government of Spain and vital military support from the National Socialist regime of Germany and the Fascist government of Italy. Franco was able to continue the civil war for two and one-half years. In August, 1939, after his troops had taken Madrid, Franco became prime minister. His government was recognized by the major powers with the exception of the U.S.S.R. Franco created his own fusion party, the *Falange Española Tradicionalista y de las Juntas de Ofensiva Nacional Sindicalistas*, known as the Falange. As *El Caudillo* ("the Chief"), Franco assumed dictatorial rule, exterminated or suppressed former Loyalists, and restored power to the Roman Catholic Church and the aristocracy.

World War II and After. At first, in World War II, Franco was friendly to the Axis powers, but as the war went on Franco gradually sought reconciliation with the Allies. After the war eco-



Francisco Franco

UPI

conomic affairs in Spain became disastrous. In 1953 Franco won economic aid from the United States in return for the installation of American military bases on Spanish territory. In later years the Spanish economy improved significantly; nonetheless, his government faced popular discontent, manifested in strikes by workers, unrest by students, and agitation by Basque nationalists. In 1947 a law was passed proclaiming Spain a kingdom and Franco the lifetime regent with the right to select his successor as chief of state. In 1969 he named as future ruler Prince Juan Carlos de Borbón y Borbón (1938–), grandson of Alfonso XIII (q.v.), King of Spain. On Oct. 30, 1975, the mortally ill dictator named Juan Carlos temporary chief of state; he died on Nov. 20. See also *SPAIN: History*.

FRANCO-GERMAN WAR or **FRANCO-PRUSSIAN WAR**, war in 1870–71 lost by France to the German States under the leadership of Prussia. The underlying causes of the conflict were the determination of the Prussian statesman Prince Otto Eduard Leopold von Bismarck (q.v.) to unify Germany under Prussian control, and, as a step toward this goal, to eliminate French influence over Germany. On the other hand, Napoleon III (q.v.), Emperor of France, sought to regain both in France and abroad the prestige lost as a result of numerous diplomatic reverses, particularly those suffered at the hands of Prussia in the Austro-Prussian war of 1866; see *SEVEN WEEKS' WAR*. In addition, the military strength of Prussia, as revealed in the war with Austria, con-

stituted a threat to French dominance on the Continent. See also histories of *FRANCE*; *GERMANY*.

Initiating Incidents. The event directly precipitating the Franco-German War was the candidacy of Leopold, Prince of Hohenzollern-Sigmaringen (1885–1905) for the throne of Spain, rendered vacant by the Spanish revolution of 1868. Leopold had accepted the candidacy under persuasion from Bismarck. The French government, alarmed at the possibility of a Prusso-Spanish alliance resulting from the occupancy of the Spanish throne by a member of the Hohenzollern (q.v.) dynastic family, threatened Prussia with war if Leopold's candidacy were not withdrawn. The French ambassador to the Prussian court, Comte Vincente Benedetti (1817–1900), was dispatched to Ems, a spa in northwestern Germany then being visited by William I (q.v.), King of Prussia, with instructions to demand of the Prussian monarch that he order Prince Leopold to withdraw his candidacy. William, although angered, gave Benedetti permission to communicate directly with Leopold by telegraph. Leopold could not be reached, but his father, Prince Charles Anthony (1811–85), wired a retraction of the candidacy in the name of his son.

The government of Napoleon III, however, was not content, but was determined to humiliate Prussia, even at the cost of war. Antoine Alfred Agénor de Gramont (1819–80), the French foreign minister, demanded that William submit a personal letter of apology to Napoleon III and a guarantee that the Hohenzollern candidacy would never be renewed. In an interview with Benedetti at Ems, the Prussian king rejected the French demands. The same day, Bismarck obtained William's authorization to publish the French demands and the Prussian rejection contained in the Ems Dispatch; Bismarck edited the document in a manner calculated to aggravate the resentment of the French and the Germans. The Prussian statesman realized that this move would in all probability precipitate war, but he knew that Prussia was prepared, and he counted on the psychological effect of a French declaration of war to rally the south German States to Prussia's cause, thus accomplishing the final phase in the unification of Germany.

The War Begins. On July 19, 1870, France declared war on Prussia. The south German States, in fulfillment of their treaties with Prussia, immediately joined King William in a common front against France. The French were only able to mobilize about 200,000 troops; the Germans, however, quickly marshaled an army of about 400,000 men. All German forces were under the

supreme command of William, with the great strategist Count Helmuth von Moltke (q.v.) as his chief of staff. Three German armies drove into France, led respectively by General Karl Friedrich von Steinmetz (1796–1877), Prince Frederick Charles (1828–85), and Crown Prince Frederick William, later Frederick III (q.v.), King of Prussia and Emperor of Germany. The first engagement, a minor skirmish, was won by the French on Aug. 2, when they drove a small Prussian detachment from the city of Saarbrücken, near the border between France and Germany. In the major battles at Weissenburg (Aug. 4), at Wörth (Aug. 6), and at Spichern (Aug. 6), however, the French under Comte Marie Edmé Patrice Maurice de MacMahon (q.v.) were defeated. MacMahon was ordered to fall back on Châlons. Marshal Achille Bazaine (1811–88), in command of all French troops east of Metz, was directed to maintain his positions. Metz itself was to be held at all costs. These orders split the French forces, which were unable thereafter to regain their unity or freedom of action. On Aug. 12 the French emperor handed the supreme command over to Bazaine, who was badly beaten in the great battles of Vionville (Aug. 15) and Gravelotte (Aug. 18), and forced into Metz. There he was besieged by two German armies. MacMahon then was ordered to relieve Metz. The Germans surprised and de-

feated (Aug. 30) his leading corps at Beaumont, whereupon he decided to withdraw his army to Sedan.

Battle of Sedan and the Capture of Napoleon III. The decisive battle of the war opened in Sedan on the morning of Sept. 1; see SEDAN, BATTLE OF. At about 7:00 A.M. MacMahon was severely wounded, and an hour and a half later General Emmanuel Félix de Wimpffen (1811–84) received the chief command. The battle continued until 4:15 P.M., when Napoleon, who meanwhile had arrived in Sedan, resumed command. Recognizing the hopelessness of the situation, he ordered the white flag to be hoisted. Terms of surrender were negotiated during the night, and on the following day Napoleon, together with 83,000 troops, surrendered to the Germans.

Upon receiving intelligence of the capture of the French emperor, Paris rose in rebellion, the Legislative Assembly was dissolved, and France was proclaimed a republic. Before the close of September, Strasbourg, one of the last points at which the French had hoped to stem the German advance, capitulated, and Paris was completely surrounded. On Oct. 7 the minister of the new French government, Léon Gambetta (q.v.), made a dramatic escape from Paris by bal-

A contemporary woodcut of Prussian artillery employed in the siege of Paris.

Bettmann Archive



FRANCONIA

loon, and with his chief assistant, Charles Louis de Saulces de Freycinet (1828–1923), carried on from Tours the organization and equipment of thirty-six military divisions. The efforts of these troops proved unavailing, however, and they were at length driven into Switzerland, where they were disarmed and interned.

Siege of Paris, French Capitulation, and German Occupation. On Oct. 27 Marshal Bazaine surrendered at Metz with 173,000 men. Paris, meanwhile, was subjected to siege and bombardment. Its citizens, attempting to stave off the enemy with crude and makeshift weapons, and reduced to eating cats, dogs, and even rats, were at length compelled, on Jan. 19, 1871, to open negotiations for surrender.

A day earlier, Jan. 18, an event had occurred that represented the culmination of Bismarck's unremitting efforts for the unification of Germany. The Prussian king was crowned William I, Emperor of Germany, in the Hall of Mirrors at Versailles (q.v.). The formal capitulation of Paris took place on Jan. 28, following which an armistice of three weeks was arranged. A French national assembly, elected to negotiate the peace, convened at Bordeaux on Feb. 13, and chose Louis Adolphe Thiers (q.v.) as the first president of the Third Republic. On March 1 the preliminaries of peace were ratified at Bordeaux. The final treaty, signed on May 10, 1871, at Frankfurt-am-Main, provided that the French province of Alsace (excepting Belfort) and part of Lorraine, including Metz, were to be ceded to the German Empire, and that France was to pay a war indemnity of 5,000,000,000 francs, submitting to occupation by German troops until the amount was rendered in full. This heavy obligation was discharged in September, 1873, and during the same month, after an occupation of almost three years, France was at length relieved of the presence of German soldiers.

FRANCONIA (Ger. *Franken*), duchy of medieval Germany, extending along both sides of the Main R., from the Rhine R. on the w. to the Fichtelgebirge mountain range on the e. It also included the territory containing the cities of Mainz, Speyer, and Worms, on the western bank of the Rhine. The region was conquered by the Franks (q.v.) in the late 5th century and soon afterward became part of the Kingdom of Austrasia. The Treaty of Verdun (843) made Franconia the center of the newly formed East Frankish, later German, kingdom, consisting of the duchies of Saxony, Swabia, Bavaria, Lorraine (qq.v.), and Franconia. Lacking political unity, however, the duchy declined in importance, and it was soon divided into Rhenish Franconia

and Eastern Franconia. In the 10th century Conrad the Red, Duke of Lorraine (d. 955), the son-in-law of Otto I (q.v.), Holy Roman Emperor, established the Franconian (Salian) family as dominant in the area. The political power of this family was first felt in 1024, when Conrad, Duke of Franconia, was elected Conrad II (q.v.), Holy Roman Emperor, thus founding an imperial house, which by its direct and collateral branches gave emperors to the Holy Roman Empire (q.v.) for more than two centuries. During this period, Eastern Franconia increased in political influence. Rhenish Franconia, however, lost its identity, and a large portion was divided among the count palatine of the Rhine, the archbishop of Mainz, and the bishops of Speyer and Worms. The remainder gradually became a land of lesser nobles and free towns. By the 13th century the name Franconia fell into disuse. It was revived in 1512, however, when Maximilian I (q.v.), Holy Roman Emperor, established the province of Franconia. With the dissolution of the Holy Roman Empire in 1806, the name Franconia disappeared from the political divisions of Germany. In 1837 Louis I, King of Bavaria (see *under* LOUIS), revived the name of the old duchy, naming the three northern portions of his kingdom Upper Franconia, Middle Franconia, and Lower Franconia. The territory comprising the old duchy of Franconia is now included in Baden-Württemberg, Hesse, and Bavaria.

FRANCONIA MOUNTAINS. See WHITE MOUNTAINS.

FRANCO-PRUSSIAN WAR. See FRANCO-GERMAN WAR.

FRANK, Anne (1929–45), teen-age diarist, born in Frankfurt-am-Main, Germany. In 1933 she and her family, who were Jewish, left Germany, then ruled by the dictator Adolf Hitler (q.v.), and settled in Amsterdam, Netherlands. In July, 1942, she and her family and four other exiles went into hiding in the sealed-off back rooms of an Amsterdam office building in order to avoid arrest by German occupation forces. In August, 1944, their hiding place was revealed and the occupants taken into custody. Anne died at Belsen in a German concentration camp (q.v.), less than one year later. Her Dutch diary, describing with humor and tenderness her two arduous years in seclusion, was found in the hiding place. Published in 1947 as *Het Achterhuis* ("The House Behind"), it appeared in the United States as *Anne Frank: The Diary of a Young Girl* in 1952. It was dramatized for the stage under the title *The Diary of Anne Frank* in 1956 and filmed in 1959.

FRANK, Ilya Mikhailovich (1908–), Soviet physicist, born in Saint Petersburg (now Lenin-grad), he received a D.Sc. degree from the University of Moscow. In 1934 he joined the P. N. Lebedev Institute of Physics, in Moscow, specializing in nuclear physics and physical optics. Frank became known for the investigations he conducted on the conversion of gamma rays into electron-positron pairs and for his research into the properties of neutrons. In 1937 Frank and Igor Yevgenievich Tamm (q.v.) worked out a theoretical interpretation for the Cherenkov effect (a phenomenon that occurs when radiation accelerates electrons traversing pure solids or liquids to speeds greater than that of light in the same medium). Frank, Tamm, and Pavel Alexeyevich Cherenkov (q.v.) were jointly awarded the 1958 Nobel Prize in physics.

FRANK, Jacob (1726–91), Polish theologian and mystic, born Jankiew Liebowicz in Podolia (now a region of the Ukrainian S.S.R.). He was the son of a rabbi and as a young man traveled in the Middle East, where the Turks called him Frank, their customary designation for a European; he retained that surname through life. At Salonika, Greece, he became a member of the religious sect founded by the Smyranean-Jewish mystic and self-styled messiah, Sabbatai Zebi (q.v.). On his return to Poland in 1755, Frank became the center of a secret semireligious society of Jews, against which charges of immorality were leveled. Subsequently, he claimed to be the recipient of direct revelations from heaven and exhorted his followers to espouse Christianity as an intermediate stage in the transition to a future Messianic religion. In 1759 the Frankists underwent a spectacular mass baptism at L'vov, Poland (now in the U.S.S.R.), at which members of the Polish nobility served as godparents. Almost at once, however, Frank's sincerity was impugned, and the Church brought charges of heresy against him, which resulted in his imprisonment in 1760. Upon his release thirteen years later, Frank, assuming the role of messiah, selected twelve apostles and settled at Brunn, Austria (now Brno, Czechoslovakia). There he attracted the favorable notice of Maria Theresa (q.v.), Archduchess of Austria, who patronized him as an apologist of Christianity to the Jews. After 1786 Frank moved to the small German town of Offenbach, where he spent the rest of his life, maintained in luxury by the donations of his worshipful followers. After the death of Frank, leadership of the sect was assumed by his daughter Eve Frank (d. 1816), but the Frankists lost their identity as a group and became communicants of the Roman Catholic Church.

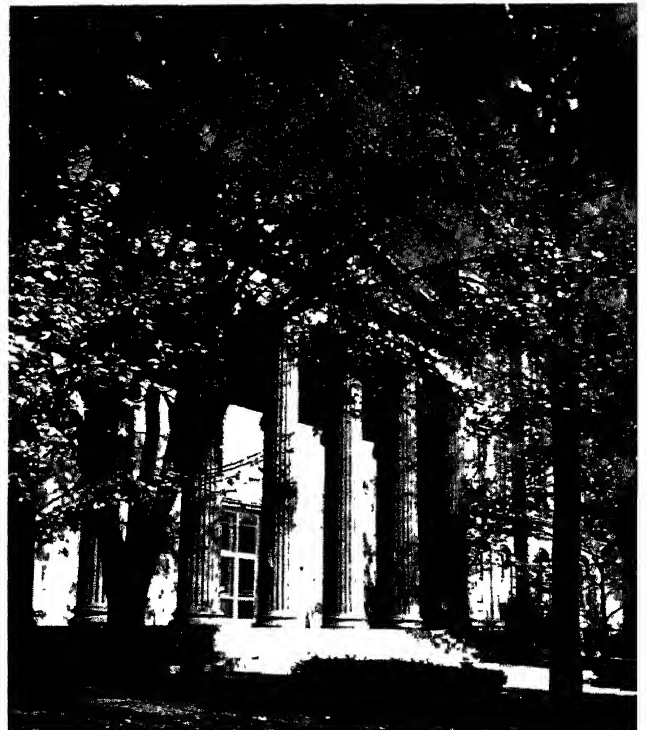
FRANKENSTEIN, title of a novel by Mary Wollstonecraft Shelley. *See under* SHELLEY.

FRANKFORT, city in Indiana, and county seat of Clinton Co., about 37 miles N.W. of Indianapolis. Manufactures include foundry products and electronic equipment. Frankfort is a processing and marketing center for the surrounding agricultural area. Pop. (1960) 15,302; (1970) 14,956.

FRANKFORT, city and capital of Kentucky, and county seat of Franklin Co., intersected by the Kentucky R., about 55 miles E. of Louisville, in the bluegrass region. Three bridges connect the two sections of the city. Frankfort is served by several railroads, and is the commercial center for a fertile area that produces tobacco, hemp, and grain, and is famous for the raising of thoroughbred race horses. Numerous limestone quarries lie in the vicinity of the city, and its principal industries are distilling, and the manufacture of underwear, shoes, machinery, and automobile parts.

Among notable buildings of Frankfort are the impressive State Capitol, constructed in 1909 in Greek revival style, and the old capitol building, dating from 1828, and now occupied by the State library and the State Historical Society. One of the items in the society collection is the pistol with which Aaron Burr shot the American statesman Alexander Hamilton (qq.v.). Liberty Hall, an old Georgian mansion with a notable

A front view of the Old Capitol, former State house of Kentucky, completed in 1828. Kentucky Historical Society



FRANKFURT

rose garden on the grounds, was designed by President Thomas Jefferson (q.v.). On one of the hills surrounding the city is Frankfort Cemetery containing the grave of the American pioneer Daniel Boone (q.v.). Frankfort is the site of Kentucky State College (1886). The city was founded in 1786 by General James Wilkinson (q.v.), and became the capital of Kentucky in 1792. Pop. (1960) 18,365; (1970) 21,356.

FRANKFURT or **FRANKFURT-AM-MAIN** (Eng. *Frankfort on the Main*), city of West Germany, in Hesse State, on both banks of the Main R., about 85 miles s.e. of Bonn. The city is a major river port and railroad center. Nearby is the international Rhine-Main Airport, one of the largest in Europe. The city was important as a commercial center as early as the 13th century, and today it is the headquarters of many of the banking, mercantile, and industrial concerns of s.w. Germany. Two semiannual fairs, the Ostermesse and the Herbstmesse, are chief factors in the commercial prosperity. Frankfurt has also been a center for printing and publishing. The principal industrial products manufactured in the city are machinery, electrical and railroad equipment, automobiles, clothing, and chemicals.

Frankfurt includes the former towns of Bornheim, Bockenheim, Niederrad, Oberrad, Seckbach, and Sachsenhausen. The city is divided into an old town, Altstadt, bordering the river, and a new town, Neustadt, n. of the older section. The old town, inhabited mainly by small tradesmen and skilled craftsmen, retains many medieval characteristics. The new town contains the business quarter and the most important public buildings. The ancestral home of the Rothschild (q.v.) family, the famous Jewish financiers, is the only reminder in Frankfurt of the Juden-Gasse, or Jewish sector. A cluster of Gothic houses, the Römer, was used as the town hall for nearly 500 years. It forms the nucleus of the Römerberg, a square flanked by medieval houses of various dates. Other places of interest are the Eschenheim Turm, a gate tower built in the 15th century; the palace of the princes of Thurn and Taxis, which was the meeting place of the North German Diet from 1815 to 1866; the Leinwand-Haus, or linen drapers' hall of the 14th century; and the house where the German poet and writer Johann Wolfgang von Goethe (q.v.) spent his youth. The outstanding church of Frankfurt is the Cathedral of Saint Bartholomew. It was constructed in the 13th century on the site of a 9th-century church and was the seat of the elections of Holy Roman emperors and, after 1562, of the imperial coronations.

Frankfurt was probably established as a Roman settlement about the 1st century A.D. In the late 8th century, it was referred to as Frankonovurd by Einhard (q.v.), biographer of Holy Roman Emperor Charlemagne (q.v.). During Charlemagne's reign a number of imperial councils were held in Frankfurt. The Golden Bull (q.v.) of 1356 established Frankfurt as the seat of the imperial elections, and it was made a free imperial city in 1372. About 1520 the city became an important stronghold of Protestantism; see REFORMATION: *National Movements: Germany and the Lutheran Reformation*. Upon the formation of the Confederation of the Rhine (q.v.) in 1806, Frankfurt became subordinate to the confederation. It regained the status of a free city in 1815, and it was the unofficial capital of the confederation until 1866. In the same year, during the Seven Weeks' War (q.v.), Frankfurt was seized by Prussia. During World War II, the city was heavily damaged. Pop. (1972 est.) 657,776.

FRANKFURT or **FRANKFURT AN DER ODER** (Eng. *Frankfort on the Oder*), city in East Germany, and capital of Frankfurt District, on the w. bank of the Oder R., about 50 mi. from Berlin. The city lies on one of the principal road and railway routes between East Germany and Poland. The principal products manufactured in the city are iron castings, agricultural machinery, hardware, chemicals, textiles, and foodstuffs. The site upon which the city stands was first settled by a group of Franconian merchants in the 13th century. It was granted a charter in 1253, and between 1368 and 1450 it was a flourishing member of the Hanseatic League (q.v.). The University of Frankfurt, founded in 1506, was transferred to Breslau in 1811. In the spring of 1945 during World War II Frankfurt was captured by Soviet troops, and following the war the city was included in the Soviet zone of occupation. Pop. (1970 est.) 677,119.

FRANKFURTER, Felix (1882–1965), American jurist, born in Vienna, Austria, and brought to the United States in 1894. He was educated at the College of the City of New York (now City College) and Harvard University. He served (1906–10) as assistant U.S. attorney in New York City and (1910–14) in the War Department. As a teacher at Harvard Law School (1914–39) he became known as a leading authority on constitutional law. A longtime adviser to President Franklin D. Roosevelt (q.v.), Frankfurter recommended to the President many of the executives that were selected to administer the agencies established under the New Deal (q.v.); and he was instrumental in writing the Securities Act

(1933), Securities Exchange Act (1934), Public Utility Holding Company Act (1935), and other New Deal legislation affecting the railroads and labor. In 1939 Roosevelt nominated Frankfurter as an associate justice of the Supreme Court of the United States (q.v.); he served on the Court until 1962, when he retired because of illness. Legal and political observers expected Frankfurter to join the liberal wing of the Supreme Court; instead, he became known as the leader of the Conservative members of that body. His philosophy was one of judicial restraint. He believed that the Supreme Court should not interfere with the rulings of State legislatures and of the United States Congress, which represent the will of the electorate. His opinions frequently supported the right of the State and Federal governments to self-protection, as in the Supreme Court ruling of 1951 upholding the conviction of eleven leaders of the Communist Party for conspiring to overthrow the government of the U.S. by force. His concern for States' rights (q.v.) is evidenced by his dissent from a Supreme Court decision in 1962, requiring reapportionment of State legislatures. Frankfurter wrote many books and articles on legal matters, including *The Case of Sacco and Vanzetti* (1927) and *Of Law and Men: Papers and Addresses, 1939-56* (1956). *Felix Frankfurter Reminisces* (1960) is an autobiography and *Roosevelt and Frankfurter* (1968) is a collection of letters exchanged by the two men between 1928 and 1945.

FRANKFURT. PARLIAMENT. See GERMANY: *History: Rise of Prussia.*

FRANKFURT, TREATY OF. See FRANCO-GERMAN WAR: *Siege of Paris, French Capitulation, and German Occupation.*

FRANKINCENSE, name applied to various gum resins, containing volatile oils, which diffuse a strong fragrance in burning. Oriental frankincense, also known as olibanum (q.v.), was held in high esteem by the ancient Jews, Greeks, and Romans for use in embalming and incense burning, and is still the most important incense resin. Common frankincense is obtained from the bark of *Picea abies*, the Norway spruce. When boiled in water and strained, the resin becomes Burgundy pitch, formerly used in making medicinal plasters.

See INCENSE; RESINS.

FRANKLAND, Sir Edward (1825-99), British chemist, born in Churchtown, Lancashire, England. For several years he was apprentice to a druggist, later serving as assistant in several laboratories. He became professor of chemistry at Owens College, Manchester, in 1851; lecturer at

Saint Bartholomew's College, London, in 1857; professor at the Royal Institution in 1863; professor at the Royal School of Mines in 1865; and professor at the South Kensington School of Science in 1881. Frankland was the first to expound in 1852 the theory of valence (q.v.). With the British astronomer Sir Joseph Norman Lockyer (q.v.), he discovered and named the element helium (q.v.) in 1868. Frankland was knighted in 1897.

FRANKLIN, city of Wisconsin, in Milwaukee Co., near the Root R., about 12 miles s.w. of central Milwaukee, of which it is a residential suburb. Pop. (1960) 10,006; (1970) 12,247.

FRANKLIN, town in Tennessee. See FRANKLIN, BATTLES OF.

FRANKLIN, Benjamin (1706-90), American printer, author, diplomat, philosopher, and scientist, born in Boston, Mass. His father, Josiah Franklin (1658-1745), a tallow chandler by trade, had seventeen children; Benjamin was the fifteenth child and the tenth son. His mother, Abiah Folger (1667-1752), was his father's second wife. The Franklin family was in modest cir-



Benjamin Franklin, marble sculpture dated 1778 by the French artist Jean Antoine Houdon.

Metropolitan Museum of Art — Gift of John Bard

cumstances, like most of the New Englanders of the time. From his eighth to his tenth year Benjamin attended grammar school, upon the completion of which he was taken into his father's business. Finding the work uncongenial, however, he entered the employ of a cutler. In his thirteenth year he was apprenticed to his brother James (1697-1735), who had recently re-

turned from England with a new printing press. Benjamin learned the printing trade, devoting his spare time to the advancement of his education. His reading included *Pilgrim's Progress* by the British preacher John Bunyan, *Parallel Lives*, the work of the Greek essayist and biographer Plutarch, *Essay on Projects* by the English journalist and novelist Daniel Defoe, and the *Essays to Do Good* by Cotton Mather the American Congregational clergyman (qq.v.). Obtaining a copy of the third volume of the *Spectator* by the British statesmen and essayists Sir Richard Steele and Joseph Addison (qq.v.), he set himself to master its prose style.

In 1721 James Franklin established the *New England Courant* (see *NEWSPAPERS: United States Newspapers*), and Benjamin, at the age of fifteen, was busily occupied in delivering the newspaper by day and in composing articles for it at night. These articles, published anonymously, won wide notice and acclaim for their pithy observations on the current scene. Because of its liberal bias, the *New England Courant* frequently incurred the displeasure of the colonial authorities. In 1722, in consequence of an article considered particularly offensive, James Franklin was imprisoned for a month and forbidden to publish his paper, and for a while it appeared under Benjamin's name.

Philadelphia and London. As a result of disagreements with James, Benjamin left Boston and made his way to Philadelphia, arriving in October, 1723. There he worked at his trade, and succeeded in making a number of friends, one of whom, Sir William Keith (1680–1749), the provincial governor of Pennsylvania, persuaded him to go to London, England to complete his training as a printer, and to purchase the equipment needed to start his own printing establishment in Philadelphia. Young Franklin took this advice, and reached London in December, 1724. As he had not received from Keith certain promised letters of introduction and credit, Franklin found himself, at eighteen, without means in a strange city. With characteristic resourcefulness, he obtained employment at two of the foremost printing houses in London, Palmer's and Watt's. His appearance, bearing, and accomplishments soon won him the recognition of a number of the most distinguished figures in the literary and publishing world.

Two years later, in October, 1726, he returned to Philadelphia, where he resumed his trade. The following year, with a number of his acquaintances, he organized a discussion group known as the "Junto", which later became the American Philosophical Society (q.v.). In Sep-

tember, 1729, he bought the *Pennsylvania Gazette*, a dull, poorly edited weekly newspaper, which he made, by his witty style and judicious selection of news, both entertaining and informative. In 1730 he married Deborah Read (1705–74), a Philadelphia girl whom he had known before his trip to England.

Projects and Experiments. Franklin engaged in many public projects. In 1731 he founded what was probably the first public library in America, chartered in 1742 as the Philadelphia Library; see *LIBRARY*. He first published *Poor Richard's Almanac* (q.v.) in 1732, under the pen name Richard Saunders. This modest volume quickly gained a wide and appreciative audience, and its homespun, practical wisdom exerted a pervasive influence upon the American character. In 1736 Franklin became clerk of the Pennsylvania General Assembly, and the next year was appointed deputy postmaster of Philadelphia. About this time, he organized the first fire company in that city and introduced methods for the improvement of street paving and lighting. Always interested in scientific studies, he devised means to correct the excessive smoking of chimneys, and invented, around 1744, the Franklin stove which furnished greater heat with a reduced consumption of fuel.

In 1747 Franklin began his electrical experiments (see *ELECTRICITY: History*) with a simple apparatus that he received from Peter Collinson (1694–1768) in England. He advanced a tenable theory of the Leyden jar (q.v.), supported the hypothesis that lightning is an electrical phenomenon, and proposed an effective method of demonstrating this fact. His plan was published in London and carried out in England and France before he himself performed his celebrated experiment with the kite in 1752. He invented the lightning rod (see *LIGHTNING*), and offered what is called the "one-fluid" theory in explanation of the two kinds of electricity, positive and negative. In recognition of his impressive scientific accomplishments, Franklin received honorary degrees from the University of Saint Andrews in Scotland and Oxford University in England. He also became a fellow of the Royal Society of London for Improving Natural Knowledge (q.v.) and in 1753 was awarded its Copley Medal for distinguished contributions to experimental science. Franklin also exerted a great influence on education in Pennsylvania. In 1749 Franklin wrote *Proposals Relating to the Education of Youth in Pennsylvania*; its publication led to the establishment in 1751 of the Philadelphia Academy, later to become the University of Pennsylvania (q.v.). The curriculum he

suggested was a considerable departure from the program of classical studies then in vogue. English and modern foreign languages were to be emphasized as well as mathematics and science. The radical change was short-lived, however; Franklin was soon to complain that the classics department was being favored.

Public Office. In 1748 Franklin sold his printing business to David Hall (1714–72). Two years later Franklin was elected to the Pennsylvania Assembly, in which he served until 1764. He was appointed deputy postmaster general for the colonies in 1753, and in 1754 he was the delegate from Pennsylvania to the intercolonial congress which met at Albany (see ALBANY CONVENTION) to consider methods of dealing with the threatened French and Indian War. His Albany Plan, in many ways prophetic of the 1787 Constitution of the United States (q.v.), provided for local independence within a framework of colonial union, but was too far in advance of public thinking to obtain ratification. It was his staunch belief that the adoption of this plan would have averted the American Revolution (q.v.).

When the French and Indian War (q.v.) broke out, Franklin procured horses, wagons, and supplies for the British commander General Edward Braddock (q.v.) by pledging his own credit to the Pennsylvania farmers, who thereupon furnished the necessary equipment. The proprietors of Pennsylvania Colony, descendants of the Quaker leader William Penn (q.v.), in conformity with their religious opposition to war, however, refused to allow their landholdings to be taxed for the prosecution of the war, and in 1757 Franklin was sent to England by the Pennsylvania Assembly to petition the king for the right to levy taxes on proprietary lands. After completing his mission, he remained in England for five years as the chief representative of the American colonies. During this period he made friends with many prominent Britons, including the chemist and clergyman Joseph Priestley, the philosopher and historian David Hume, and the philosopher and economist Adam Smith (qq.v.).

Franklin returned to Philadelphia in 1762, remaining until 1764, when he was once again dispatched to England as the agent of Pennsylvania. In 1766 he was interrogated before the House of Commons regarding the effects of the Stamp Act (q.v.) upon the colonies, and his testimony was largely influential in securing the repeal of the act. Soon, however, new plans for taxing the colonies were introduced in Parliament, and Franklin was increasingly divided between his devotion to his native land and his

loyalty as a subject of George III (q.v.), King of Great Britain. At length, in 1775, Franklin's powers of conciliation exhausted, he sorrowfully acknowledged the inevitability of war. Sailing for America after an absence of eleven years, he reached Philadelphia on May 5, 1775, to find that the opening engagements of the revolution, the battles of Lexington and Concord, had already been fought. He was chosen a member of the second Continental Congress (see CONTINENTAL CONGRESS), serving on ten of its committees, and was made postmaster general, which office he held for one year.

Diplomat of the Revolution. In 1775 Franklin made a journey to Canada, suffering great hardship along the way, in a vain effort to enlist the cooperation and support of Canada in the revolution. Upon his return, he became one of the committee of five chosen to draft the Declaration of Independence (q.v.). He was also one of the signers of that historic document, making before the assembly the characteristic statement: "We must all hang together, or assuredly we shall all hang separately". In September of the same year, he was chosen, with two other Americans, Arthur Lee (see under LEE) and Silas Deane (q.v.), to solicit economic assistance in France. His scientific reputation, his integrity of character, and his wit and gracious manner made him extremely popular in French political, literary, and social circles, and his wisdom and ingenuity secured for the U.S. aid and concessions which perhaps no other man could have obtained. Against the vigorous opposition of the French minister of finance, Jacques Necker (q.v.), and despite the jealous antagonism of his coldly formal American colleagues, he managed to obtain liberal grants and loans from Louis XVI (q.v.), King of France. Franklin encouraged and materially assisted American privateers operating against the British navy, especially John Paul Jones (q.v.). On Feb. 6, 1778, Franklin negotiated the treaty of commerce and defensive alliance with France which represented, in effect, the turning point of the American Revolution. Seven months later, he was appointed by Congress as the first minister plenipotentiary from the United States to France.

In 1781 Franklin, John Adams, and John Jay (qq.v.) were appointed to conclude a treaty of peace with Great Britain. The final treaty was signed at Versailles, France, on Sept. 3, 1783; see PARIS, TREATY OF. During the remainder of his stay in France, Franklin was accorded honorary distinctions commensurate with his notable and diversified accomplishments. His scientific standing caused the French king to appoint him

FRANKLIN

as one of the commissioners investigating the Austrian physician Franz Anton Mesmer (q.v.) and the phenomena of animal magnetism. As a high dignitary of one of the most distinguished Freemason lodges (see FREEMASONS) in France, Franklin had the opportunity of meeting and speaking with a number of the philosophers and leading figures of the French Revolution (q.v.), upon whose political thinking he exerted a profound influence. Although he favored a liberalization of the French government, he opposed change through violent revolution.

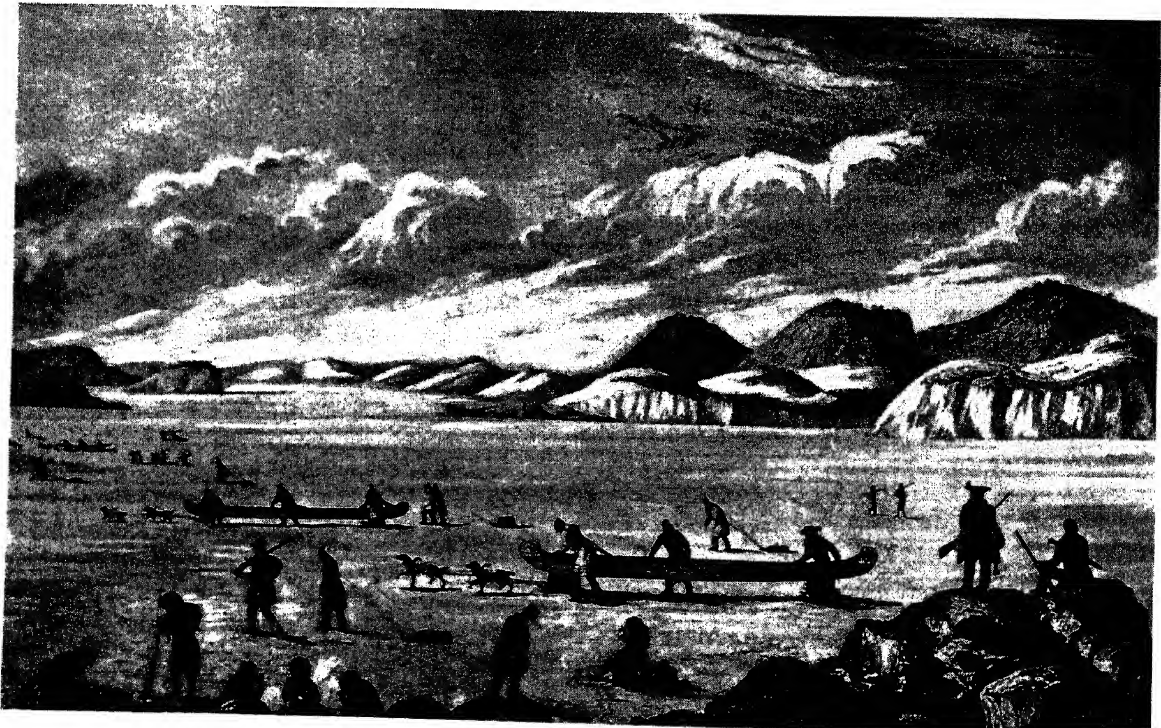
A Framer of the Constitution. In March, 1785, Franklin, on his own request, left his duties in France. No sooner had he returned to Philadelphia, however, than he was chosen president of the Pennsylvania executive council, which office he filled for a period of two years. In 1787 he was chosen a delegate to the convention which drew up the Constitution of the U.S. Franklin was deeply interested in philanthropic projects, and one of his last public acts was to sign a petition to the United States Congress, on Feb. 12, 1790, as president of the Pennsylvania Abolition Society, urging the abolition of slavery (q.v.) and the suppression of the slave trade. Two months later, on April 17, he died in his Philadelphia home at the age of eighty-four.

Franklin's notable service to his country was

the result of his great skill in diplomacy. To his common sense, wisdom, wit, and industry, he joined great firmness of purpose, matchless tact, and broad tolerance. Both as a brilliant conversationalist and a sympathetic listener, Franklin had a wide and appreciative following in the intellectual salons of the day. His literary reputation rests chiefly on his unfinished *Autobiography*, which is considered by many to be the true epitome of his life and character.

FRANKLIN, Sir John (1786–1847), British rear admiral and arctic explorer, born in Spilsby, Lincolnshire, England. He participated in the battles of Copenhagen in 1801 and Trafalgar in 1805 during the Napoleonic Wars (q.v.). In 1818 he commanded the *Trent* in an unsuccessful voyage to the arctic, and from 1819 to 1822 he commanded an overland expedition commissioned to explore the northern coast of Canada east from the mouth of the Coppermine R. In a subsequent arctic expedition from 1825–27, Franklin traced the North American coastline from the mouth of the Mackenzie R. on the Beaufort Sea in N.W. Canada to about the 150th meridian in N.E. Alaska. In 1829 he was knighted and awarded the gold medal of the Geographical Society of Paris. From 1836 to 1843 he was lieutenant governor of Van Diemen's Land (now Tasmania) where he established a college and scientific society. In 1845 he was appointed commander of an expedition to discover the

An engraving of the first expedition of Sir John Franklin to the northern coast of Canada, 1819–22.



Northwest Passage (q.v.). The expedition, consisting of the *Erebus* and the *Terror*, with 129 officers and men, was last seen, by a whaling vessel, on July 26, 1845, in Baffin Bay.

Between 1848 and 1859 numerous searching expeditions were dispatched to the Arctic. In July 1857 Lady Jane Franklin (1792–1875), Franklin's second wife, outfitted the *Fox*, which was finally successful in discovering the history of the ill-fated expedition. The search party obtained from the Eskimo in Boothia Peninsula many relics of the Franklin expedition. A record found at Victory Point related details of Franklin's expedition up to April 25, 1848.

In 1846 the *Erebus* and *Terror* had navigated Peel Sound and Franklin Strait in a southerly direction, but had been stopped by ice between Victoria Island and King William Island. The two ships, icebound from September, 1846, had been deserted on April 22, 1848. At that time the total casualties had been nine officers and fifteen men, including Franklin, who had died on June 11, 1847. The surviving members of the party left the ships on April 26, 1848, but apparently perished some days later. Between 1878 and 1880 a United States expedition discovered the wreckage of one of Franklin's ships, and skeletons of members of his party. A monument erected in 1875 in Westminster Abbey (q.v.) commemorates Franklin as the discoverer of the Northwest Passage.

FRANKLIN, William (1731–1813), American colonial administrator, illegitimate son of the American statesman and scientist Benjamin Franklin (q.v.), born in Philadelphia, Pa. Before he was twenty-one years old, he was commissioned as a captain to serve with the Pennsylvania forces on the Canadian frontier during King George's War (q.v.). In 1754 his father, then postmaster general, appointed him comptroller of the Philadelphia post office. Franklin held the post until 1756, also serving as clerk of the Pennsylvania Provincial Assembly during part of that period. In 1757 he accompanied his father to London, England, studied law, and was admitted to the bar in London in 1758. He was appointed governor of New Jersey in 1763 and as a defender of royal authority was in constant conflict with the colonists. He remained a Loyalist during the American Revolution. Arrested by order of the Provincial Congress of New Jersey in 1776, he was detained until 1778. In 1782 he went to England, where he lived until his death.

FRANKLIN AND MARSHALL COLLEGE, institution of higher education for men, situated in Lancaster, Pa. The college was established in 1852 by the merger of Franklin College, which

had been founded in Lancaster in 1787, and Marshall College, organized in Mercersburg, Pa., in 1836. The college confers the degrees of bachelor of arts and bachelor of science; no graduate courses are offered. In 1968 the college library housed more than 190,000 bound volumes. In 1968 student enrollment totaled 2417, the faculty numbered 137, and the endowment of the college was about \$10,025,000.

FRANKLIN, BATTLES OF, battles of the American Civil War (see CIVIL WAR, THE AMERICAN), the most important of which was fought on Nov. 30, 1864, near Franklin, a town in central Tennessee. The Union general John McAllister Schofield was under orders to retreat before the Confederate general John Bell Hood, until the main body of the Union army under General George Henry Thomas (qq.v.) could be reinforced. Schofield retreated from Pulaski, Tenn., to Franklin, where he was temporarily immobilized by the lack of bridges across the Harpeth R. Hood, with a force of 27,000 troops, immediately attacked the slightly larger Union army of 28,000. The battle, which lasted nine hours, was indecisive. Confederate casualties totaled 6500, and Union casualties, 2326. An indecisive engagement occurred in the same vicinity in March, 1863, between Union forces and troops under Confederate General Nathan Bedford Forrest (q.v.).

FRANKLIN D. ROOSEVELT ISLAND, or ROOSEVELT ISLAND. See WELFARE ISLAND.

FRANKLIN INSTITUTE, THE, in full THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA FOR THE PROMOTION OF THE MECHANIC ARTS, institution organized in Philadelphia in 1824 for the promotion and study of applied science and the mechanic arts; it is the oldest institution of its kind in the United States. Immediately after its organization, the institute started a series of classes in the liberal arts and in technological subjects; out of these classes grew Franklin High School, the first public high school in the city, which was discontinued at the advent of the public high-school system. In 1933, through the joint efforts of the institute and the Benjamin Franklin Memorial Foundation, a building was erected as a permanent memorial to Benjamin Franklin (q.v.). The building includes a museum containing exhibits that demonstrate the fundamentals and applications of science, the Fels Planetarium (see PLANETARIUM), and a memorial hall containing a heroic statue of Franklin by the American sculptor James Earle Fraser (q.v.). The *Journal* of the Franklin Institute, published continuously since 1826, publishes papers on the latest scientific developments and their application to industry.

FRANKLINITE

The library of the institute, one of the finest technical libraries in the U.S., contains over 250,000 volumes and 3500 current periodicals. It is also noted for its complete literature on patents. The institute's Committee on Science and the Arts annually awards medals and premiums for distinctive contributions to the advancement of science. Among the distinguished men who have received the highest award, the Franklin Medal, are Thomas Alva Edison, Orville Wright, Albert Einstein, Harlow Shapley, Enrico Fermi, and Marshall W. Nirenberg (qq.v.). Two research laboratories are maintained by the institute: The Franklin Institute Research Laboratories, organized in 1946 for the purpose of performing research for industry in the physical and engineering sciences and for the national defense; and the Bartol Research Foundation, established in Swarthmore, Pa., in 1921 to study the fundamental problems of physical science. **FRANKLINITE**, mineral containing the oxides of iron, manganese, and zinc. It crystallizes in the isometric system and occurs chiefly as octahedral crystals. It also occurs as rounded grains and compact masses. It is slightly magnetic, iron-black in color, and has a metallic luster. Its specific gravity ranges from 5.07 to 5.22 and its hardness from 5.5 to 6.5. In the United States it occurs in considerable quantity in Franklin, N.J., for which it is named.

FRANKLIN PARK, village of Illinois, in Cook Co., about 15 miles N.W. of Chicago. The village manufactures pipes, wires, television sets, cement blocks, and steel products. Franklin Park was incorporated in 1892. Pop. (1970) 20,497. **FRANKLIN SQUARE**, unincorporated suburban residential area of New York, on Long Island, in Nassau Co., part of the town of Hempstead, 3 miles W. of Hempstead village and about 16 miles E. of New York City. Manufactures include machinery, electrical equipment, apparel, phonograph records, and cement blocks. Pop. (1960) 32,483; (1970) 32,156.

FRANKLIN, STATE OF, in American history, autonomous state, now included in the eastern part of Tennessee, formed in 1784 and dissolved in 1788. In 1784 North Carolina ceded to the United States government the western lands, a portion of which had originally been governed by a self-constituted Watauga Association (q.v.). The cession was to be accepted within one year, but North Carolina repealed the cession before the year had expired. Before learning of the repeal, the settlers in the eastern counties had organized the State of Franklin, named in honor of Benjamin Franklin (q.v.), and elected John Sevier (1745-1815) as governor. North Carolina at-

tempted to conciliate the westerners by creating a Washington District with Sevier as brigadier general and David Campbell as judge, thus removing the necessity of taking court cases across the mountains for trial; the settlers, however, decided to continue the separate-state movement. Congress failed by two votes to gain the two thirds majority necessary for passage of a resolution to accept the North Carolina cession. North Carolina refused, until 1789, to remake the cession and encouraged opponents of Sevier, led by John Tipton, to maintain North Carolina government in the Franklin area. For three years the governments of North Carolina and Franklin attempted to govern the same people and region. The government of Franklin had a constitution providing for the payment of taxes and salaries in the produce of the country. An even more democratic constitution, which would have renamed the state Frankland, was rejected through the influence of Sevier. The feud between Sevier and Tipton reached the point of hostilities, and Sevier was arrested by North Carolina on a charge of high treason. The charge was later dropped, and Sevier was seated in the North Carolina legislature and in Congress. The legislature ceded the Tennessee country a second time; Congress accepted the cession in 1790 and created the Territory South of the River Ohio, which became the State of Tennessee in 1796. S.J.F.

FRANKLIN STOVE. See FRANKLIN, BENJAMIN.

FRANKS, name applied, about the middle of the 3rd century A.D., to the Germanic tribes dwelling along the middle and lower Rhine R. They appeared in the Roman provinces around 253 A.D. and soon thereafter established themselves in two distinct groups, the Salian Franks and the Riparian Franks. The Salian Franks inhabited the territory along the lower stretches of the Rhine, and the Riparian Franks lived along its middle course. The Salians were conquered by the Roman emperor Julian (q.v.) in 358, and became allies of the Romans. During the first decade of the 5th century, when the Roman legions retired from the banks of the Rhine, the Salians established themselves in the territory between the Meuse and Scheldt rivers.

Under the Salian king Clovis I (q.v.), founder of the Merovingian (q.v.) dynasty, the power and extent of the Frankish kingdom grew considerably. In 486 Clovis overthrew Syagrius (430?-86) the last Roman governor in Gaul, and then successively subjugated the Alamanni (q.v.) confederation of German tribes, the Burgundians (see BURGUNDY), the Visigoths of Aquitania (see GOTHs: *Visigoths*), and the Riparian



The Franks offering a sacrifice to insure the success of an invasion of Gaul in the 4th century.

Franks. Ultimately, the borders of his Frankish kingdom extended from the Pyrenees Mts. to Friesland and from the Atlantic Ocean to the Main R. Clovis was converted to Christianity in 496, and thus began the close connection between the Frankish monarchy and the papacy.

After the death of Clovis, his kingdom was divided among his four sons. Thierry I (r. 511–34) ruled at Metz, Chlodomer (494–after 524) at Orléans, Childebert I (r. 511–58) at Paris, and Clotaire I (r. 511–58) at Soissons. Thuringia, Burgundy, and Provence were acquired before 558. In that year, Clotaire I (r. 558–61) became sole ruler of all the Frankish lands. At Clotaire's death, the kingdom was in turn divided among his four sons. The eastern part of the kingdom was known as Austrasia, the western part as Neustria (q.v.). Rule of Austrasia, with a population predominantly Germanic, fell to Sigebert I (535–75), who made his capital at Metz; Neustria was assigned to Chilperic I (r. 561–84), who ruled at Soissons; Charibert (d. 567) received Aquitaine; and Burgundy, with its capital at Orléans, was ruled by Guntram (d. 592). When Charibert died, his dominions were divided among his brothers. In the period that followed, because of internecine strife among the Franks, there was a decline in Merovingian power. Clotaire II (r. 584–628) in 613 once more reunited the lands of the Frankish crown. Thenceforth,

however, the kings ceased to exercise any influence, and authority passed into the hands of the great officers of state, most notably the mayor of the palace (*major domus*). The office of *major domus* existed in all of the Frankish kingdoms. In Austrasia, however, arose a powerful family, the Carolingian (q.v.), which retained exclusive possession of the palace mayoralty for over a hundred years, ruling as monarchs in fact if not in name. In 687 Pepin of Herstal (see under PEPIN), the Austrasian mayor of the palace, overthrew the forces of Neustria and Burgundy, setting himself up as *major domus* of a united Frankish kingdom. His son, Charles Martel (q.v.), who reigned from 715 to 741, extended the frontiers of the kingdom in the east, and in 732 repelled the Moors (q.v.) in a decisive battle fought at a site between Tours and Poitiers (qq.v.). Charles' son, Pepin the Short (see under PEPIN), ruled jointly with his brother Carloman (d. 754) until 747, and after that, alone. In 751, Childeric III (r. 741–51), the last of the Merovingians, was deposed by Pepin the Short, who thereupon ascended the Frankish throne with the consent of Pope Zacharias (r. 741–52).

Under Charlemagne (q.v.), the son of Pepin the Short, Frankish power attained its greatest development. Germans and Latins were united in his vast kingdom, which extended from the

FRANZ JOSEF LAND

Ebro R. in Spain to the Eider R. in Germany, and from the North Sea to Croatia and Slavonia. Charlemagne, then the most powerful monarch in Europe, also became the secular head of the Roman Catholic Church, continuing in this manner the tradition of the old Roman Empire. On Dec. 25, 800, he was crowned Carolus Augustus, Emperor of the Romans, by Pope Leo III (see under LEO); see also HOLY ROMAN EMPIRE. Charlemagne's son and successor, Louis I (q.v.), proved unequal to the task of holding together the huge empire which his father had created. The closing years of his reign were increasingly disturbed by civil strife. In 841, the year after Louis' death, his three sons fought among themselves for preeminence. Two years later, at Verdun, the Frankish Empire was partitioned among Louis' sons, Lothair I (see under LOTHAIR) and Charles II (q.v.), both of whom were kings of Germany and Holy Roman emperors, and Louis II, King of Germany (see under LOUIS); see also VERDUN, TREATY OF. This division marks the virtual end of the Frankish Empire. See FRANCE: History.

FRANZ JOSEF LAND (Russ. *Zemlya Frantsa Iosifa*), archipelago of the Soviet Union, in the Russian S.F.S.R., in the Arctic Ocean, E. of the Norwegian archipelago Svalbard and N. of Novaya Zemlya archipelago. The archipelago, of volcanic origin, has ice-covered mountains of basalt formation which attain heights of about 2400 ft. above sea level. Franz Josef Land comprises about a hundred small islands separated by bays, fjords, and straits. The principal islands are Alexandra, Graham Bell, Wilczek, Rudolf, and Hooker islands.

Because most of the land area is covered by ice, vegetation is limited to lichens, mosses, and some flowering plants. Animal life includes polar bears, foxes, walruses, ringed seals, and a number of species of sea birds. Insects are rare, with only about six species being found. The climate is arctic, the temperature varying from -19° F. in winter to 35° F. in summer. Dense fog and violent gales are frequent. At other times, however, the sky is clear and displays of the aurora borealis may be seen; see AURORA.

Discovered in 1873 by the Austro-Hungarian expedition of Julius von Payer (1842-1915) and Karl Weyprecht (1838-81), the islands were named after Francis Joseph I (q.v.), Emperor of Austria. The complete exploration of the archipelago was accomplished by various expeditions between 1880 and 1905. The Soviet Union annexed Franz Josef Land in 1926 and subsequently established government observation stations there.

FRASER, river of S. British Columbia, Canada. It rises in the Rocky Mts., in Mt. Robson Provincial Park near the Alberta border, and flows 1368 km (850 mi.) before emptying, through a delta, into the Strait of Georgia, near Vancouver.

The Fraser initially flows N.W., through a section of the Rocky Mountain Trench. It then turns S. near the city of Prince George, where it receives its major W. tributary, the Nechako R. In its central section, the volume of the river increases, and below Quesnel its banks gradually take on a canyonlike aspect. Important tributaries in this section include the West Road and Chilcotin rivers, from the W., and the Thompson R., from the E. From Lytton to Yale the river flows through a canyon of great scenic beauty as it traverses a part of the Coast Mts. A little below Yale, at Hope, the Fraser turns sharply W., and the fertile lower Fraser valley begins. The Fraser empties into the Strait of Georgia through three main channels. The river is used by commercial vessels for a short distance upstream. From May to July the Fraser valley is subject to flooding; a series of dikes helps protect the delta.

The Fraser drains an area of about 238,000 sq. km (91,892 sq. mi.). Much of the river basin is heavily wooded, and forest-products industries dominate the economy of the settlements along the river. The lower Fraser valley, including the delta, has highly productive farms. Various species of salmon, notably sockeye, spawn in the Fraser, and salmon fisheries are located near the river's mouth. The river has great hydroelectric potential, but it remains undeveloped for fear of detrimental effects on the migratory habits of the salmon.

The first European to visit the river was (1793) Sir Alexander Mackenzie (q.v.). It is named for the fur trader Simon Fraser (1776-1862), who explored much of it in 1808. In 1858 gold was found in alluvial gravels N. of Yale, and a major gold rush ensued.

FRASER, James Earle (1876-1953), American sculptor, born in Winona, Minn. He studied at the Art Institute of Chicago and with the French sculptor and painter Jean Alexandre Joseph Falguière (1831-1900) at the École des Beaux-Arts and at the Académie Julian, in Paris. His first Paris exhibition, in 1897, impressed the American sculptor Augustus Saint-Gaudens (q.v.), who asked Fraser to become his assistant. In 1906 he became an instructor at the Art Students' League in New York City, where he was also director for many years. He designed the U.S. five-cent piece with an Indian head and a buffalo in 1913, and the Victory Medal in 1919. During his lifetime Fraser won many medals

Members of the Ancient Order of Druids meet annually in London to participate in a ceremonial celebration of the autumnal equinox.
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and awards for his work and was president of the National Sculpture Society in 1925–26. In the early 1930's he was called to Washington, D.C., to execute several sculptures for government buildings. Among these works are the statues of President Theodore Roosevelt and the American statesman Alexander Hamilton. Other sculptures include "Journey Through Life" (Rock Creek Cemetery, Washington, D.C.) and "The End of the Trail" (National Cowboy Hall of Fame and Western Heritage Center, Oklahoma City, Okla.), a white plaster statue of an exhausted Indian warrior slumped over the back of his horse.

FRATERNAL ORDERS or **FRATERNAL SOCIETIES**, in the United States as generally defined in law, voluntary nonprofit associations established for the mutual aid and sociability of their members. They are also called fraternal societies or benefit associations. These orders generally provide for the payment of death and other benefits, mainly through a form of insurance known as fraternal insurance. In this respect they are the American counterpart of the British friendly societies that originated in the 16th century. Most U.S. fraternal orders, however, were patterned after certain European benevolent, secret societies modeled on the order established by the Freemasons (see FREEMASONRY). These prototypes included such organizations as the Independent Order of Odd Fellows, the Ancient Order of Druids, and the Ancient Order of Foresters, introduced into the U.S. in 1819, about 1830, and 1832, respectively. From these and similar associations fraternal or-

ders of the U.S. derived their lodge system of organization and democratic form of representative self-government; their practice of doing business in confidential meetings; and their ritualism and social characteristics.

The first fraternal order of American origin was the Improved Order of Red Men, established in 1833, which included in its ritual many American Indian customs. During the latter half of the 19th century the number and size of fraternal orders in the U.S. greatly increased. A mark of their influence was the adoption of the lodge form of organization by a number of trade unions. A notable fraternal association of the time, organized in behalf of workers, was the Jefferson Lodge Number 1 of the Ancient Order of United Workmen, organized in Meadville, Pa., in 1868. Many other fraternal associations were modeled on the Jefferson Lodge, but the subsequent efforts of workingmen to improve their conditions through trade unions tended to restrict the usefulness to labor of fraternal associations. Another factor that limited the scope of fraternal orders was the increasing urbanization of American life that became especially marked during the first decades of the 20th century. As cities and towns grew, they offered a multitude of social activities with a consequent decline in the need for the social functions performed by the fraternal orders. Nonetheless the fraternal orders are still numerous and include millions of members. Among the large orders, in addition to the Freemasons and the Odd Fellows, are the Order of the Eastern Star, the Mod-

FRATERNITIES, SORORITIES, AND SOCIETIES

ern Woodmen of America, the Benevolent and Protective Order of Elks, the Knights of Pythias, and the Knights of Columbus. See separate articles for some of the organizations mentioned above.

FRATERNITIES, SORORITIES, AND SOCIETIES, associations comprised mainly of college and university students in the United States, established to further the social, scholastic, and professional interests of the members. Because they are almost without exception designated by letters of the Greek alphabet, they are frequently called Greek-letter societies. Fraternities, sororities, and societies are self-governing associations and are generally classified as social fraternities and sororities, professional fraternities and sororities, and honor and recognition societies.

Social fraternities and sororities, comprised respectively of male and female undergraduate students in colleges and universities, organize the social life of the members. Membership in these associations is exclusive, and is by invitation and initiation at a secret ritual; upon graduation from college, the member acquires alumni status, which he retains throughout his life. Most social fraternities and sororities impose secret obligations on their members and have secret and distinctive handgrips and passwords that enable members unacquainted with one another to verify their common membership. Members of one social fraternity or sorority may not be members of other similar associations. Social fraternities and sororities are found in most of the colleges and universities of the U.S. Kappa Alpha Society, the oldest social fraternity in continuous existence, was founded in 1825; Alpha Delta Pi, the oldest sorority was established in 1851 as the Adelphean Society.

Professional fraternities and sororities invite the membership of students and faculty involved in a specific professional or vocational field, for example, journalism, law, medicine, or music. In other respects they resemble the social Greek-letter societies, the members of which are also eligible for membership in the professional associations. One of the oldest professional societies is Phi Delta Phi, a legal fraternity founded in 1869.

Honor and recognition societies are comprised mostly of students enrolled in colleges of arts and sciences who achieve distinction in scholarship and meet with the standards of character and other requirements established by the societies. A number of honor societies are limited to those fulfilling high standards of scholarship in a single field of study, for ex-

ample, engineering, or to those who display outstanding qualities of leadership among their fellow students. Some honor societies include both male and female students; others are restricted to members of one sex. Members of honor societies may be members of other Greek-letter societies. The oldest, largest, and most distinguished of such honor societies is Phi Beta Kappa (q.v.), the oldest association of college students in the country, which was founded as a social fraternity in 1776 and reorganized as an honor society in 1883. The second oldest honor society is Tau Beta Phi, established in 1885 for students who achieve distinction in the study of engineering.

Most fraternities, sororities, and societies are organized on a national basis. Constituent subdivisions, called chapters, are chartered by the national association on the basis of one chapter to a college or university. In 1902 a group of sororities created the National Panhellenic Conference, a representative advisory body that guides sorority relations and practices. In 1909 fraternity representatives formed the Interfraternity Conference, a similar organization that has been known as the National Interfraternity Conference since 1931. Social fraternities and sororities number about 100, and there are about 175 fraternities and sororities organized as professional associations and honor and recognition societies.

FRATICELLI (It., "little brothers"), in a general sense, members of the religious orders (see **ORDERS, RELIGIOUS**) founded in Italy in the 13th century, especially the Franciscans (q.v.). The name also refers to members of the groups that separated from the Franciscans in the 14th and 15th centuries, charging the order with improper views regarding poverty. One of the earliest of these divergent groups, known as the Franciscan Celestines, or Spirituals, practiced severe asceticism. This group was declared heretical and ordered suppressed by Pope John XXII (see under **JOHN**) in 1317. In reply, the Celestines declared themselves not only the sole rightful Franciscan order, but the only true Catholics as well, condemning the entire church as heretical and declaring the papal decrees invalid. Small groups of Fraticelli continued their activities for more than a century. The church took strong measures against them in the 15th century, however, and, their popular support diminishing, the Fraticelli eventually disappeared.

FRAUD, in law, general term for any instance in which one party deceives or takes unfair advantage of another. Any means used by one person to deceive another may be defined as fraud.

For example, if a person represents himself as the agent of a business with which he is unconnected, and causes another to contract with him to the other party's disadvantage or injury, the first party is guilty of fraud; see **CONTRACT**. Again, if one, in making a contract, obtains an unjust advantage because of the youth, defective mental capacity, or intoxicated condition of the other party to the contract, he is guilty of fraud. To maintain a legal action based on so-called actual fraud, it is necessary to prove the following: that a representation was made as a statement of fact; that it was untrue, and known to be untrue; that it was made with intent to deceive and to induce the other party to act upon it; and that the other party did rely on it, and was induced to act or not to act, to his injury or damage.

In equity, fraud includes any act, omission, or concealment, involving a breach of legal or equitable duty or trust, which results in disadvantage or injury to another; see **LAW: Equity**. An example of fraud in this sense is the act of an insolvent who contrives to give one of his creditors an advantage over the others; another example is the collusive act of a husband and wife in obtaining a divorce (q.v.). Fraud can also be constructive, that is, deemed fraud by interpretation. The sole difference in the case of constructive fraud is that no dishonest intent need be adduced. It arises from a breach of duty, such as the breach of a fiduciary relationship. **FRAUNCES TAVERN.** See **MANHATTAN: Architectural Features**.

FRAUNHOFER, Joseph von (1787–1826), German optician and physicist, born in Straubing. He started his career as an apprentice to a glass grinder. By 1809 most of the mechanical work in the optical institute in Benedictbeuern, near Munich, was under his direction. In 1823 Fraunhofer became a member of the Academy of Science at Munich and its conservator of physics.

Fraunhofer instituted many improvements in the manufacture of optical glass, in the grinding and polishing of lenses, and in the construction of telescopes and other optical instruments. He also invented a number of scientific instruments. His name is associated with the fixed, dark lines in the solar spectrum, called Fraunhofer lines (q.v.), which he was the first to observe and study. His investigations in the refraction and dispersion of light led to the invention of the spectroscope and the science of spectroscopy. See **SPECTRUM**.

FRAUNHOFER LINES, dark lines identifiable in the absorption spectrum of the sun, first ob-

served and studied by the German physicist and optician Joseph von Fraunhofer (q.v.); see **SPECTROHELIOGRAPH**; **SPECTRUM**; **SUN**. Fraunhofer observed the thousands of lines that exist in the spectrum, and mapped 576 of them, assigning letters to identify the most prominent lines. Some of these are:

A	(extreme red)	made by terrestrial oxygen
B	{	" " "
C	{	" " solar hydrogen
D ₁	{	" " sodium
D ₂	{	" " "
E	(green)	" " "
F	(blue)	" " iron
G	(violet)	" " hydrogen
		" " iron and calcium
		" " group
H	(extreme violet)	" " calcium

The solar lines are the result of light absorption by gases and vapors in the atmosphere (q.v.) of the sun.

FRAZER, Sir James George (1854–1941), British anthropologist, born in Glasgow, Scotland, and educated at the universities of Glasgow and Cambridge. He was elected a fellow of Trinity College, Cambridge, in 1879, and was made a professor of social anthropology at the University of Liverpool in 1907. Frazer's work covered a wide area of anthropological research. He was especially interested in the study of myth and religion. He is best known for his book *The Golden Bough* (1890), a study of ancient cults, rites, and myths. This book, which established Frazer's reputation as a distinguished scholar, was expanded into a series of twelve volumes in 1915. Frazer was knighted in 1914. He wrote many other works, including *Totemism and Exogamy* (1910), *Man, God, and Immortality* (1927), and *Creation and Evolution in Primitive Cosmogonies* (1935).

FRÉCHETTE, Louis Honoré. See **CANADIAN LITERATURE: French-Canadian Literature**.

FRECKLES. See **PIGMENT**.

FREDERICK, city in Maryland, and county seat of Frederick Co., on a tributary of the Monocacy R., 45 miles N.W. of Baltimore. It is the center of a farming and dairying area noted for prize cattle and draft horses. Industrial establishments in the city include canneries, and factories manufacturing cooking utensils, leather goods, clothing, and electronic equipment.

Frederick is the site of Hood College, established in 1893, and of Maryland State School for the Deaf. In Mt. Olivet Cemetery, within the city, are the graves of the Civil War heroine Barbara Fritchie and Francis Scott Key (qq.v.), writer of "The Star-Spangled Banner". The cemetery also contains the graves of 300 "Unknown Confederates". The city also has a museum displaying relics of Barbara Fritchie, and the es-

FREDERICK

tate of the American jurist Roger Brooke Taney (q.v.), dating from 1799.

Frederick was settled in 1733 by Palatine Germans. It was incorporated as a city in 1817. During the Civil War it was occupied alternately by Union and Confederate troops. In 1864 the Confederate general Jubal Anderson Early (q.v.) levied a ransom of \$200,000 on the city. Pop. (1960) 21,744; (1970) 23,641.

FREDERICK, name of several European emperors and kings. Brief accounts of less important rulers are included in this article under the names of the countries which they ruled. The more important monarchs are described in separate biographical articles, to which the reader is referred.

The English name Frederick appears in Danish and Norwegian as *Frederik*, in German as *Friedrich*, in Italian as *Federigo* or *Federico*, and in Swedish as *Fredrik*.

DENMARK

Nine kings of Denmark were named Frederick; the first six, Frederick I through Frederick VI, were also kings of Norway.

Frederick I (1471?–1533), King of Denmark and Norway (1523–33, son of Christian I (see under CHRISTIAN) and brother of John I (see under JOHN). He was elected to succeed his deposed nephew, Christian II (see under CHRISTIAN) of Denmark and Norway. Frederick granted the nobility many privileges, thereby diminishing the power of the throne. A convert to Lutheranism, he spread that faith in his dominions.

Frederick II (1534–88), King of Denmark and Norway (1559–88), son of Christian III (see under CHRISTIAN). In 1559, after becoming king, he conquered the independent republic of Dithmarschen (now a region of Germany) in the western part of the duchy of Holstein. In 1563 he began a war with Sweden, which was settled under the terms of the Peace of Stettin (1570). During the latter part of his reign, which was peaceful, he suppressed piracy on the North and Baltic seas and built the fortress-castle of Kronborg in Helsingør (Elsinore). The castle is the setting of William Shakespeare's *Hamlet*.

Frederick III (1609–70). See FREDERICK III, King of Denmark.

Frederick IV (1671–1730), King of Denmark and Norway (1699–1730), son of Christian V (see under CHRISTIAN). In 1700 Frederick became an ally of Russia and Poland against Sweden in the Great Northern War, but he was soon compelled by Charles XII (q.v.), King of Sweden, to withdraw from the conflict and to promise not to reenter it. After the defeat of Charles at Poltava (now in the Ukrainian S.S.R.) in 1709, Fred-

erick again declared war on Sweden, subsequently taking the German duchy of Schleswig and participating with the Poles in the invasion of the Swedish portion of Pomerania. By treaty in 1720 Frederick agreed to return all conquests made in the war, except for Schleswig. Among the accomplishments of his reign was the freeing of the peasants from serfdom in 1702. **Frederick V** (1723–66), King of Denmark and Norway (1746–66), son and successor of Christian VI (see under CHRISTIAN). Little interested in the affairs of state, he left control of the government largely to his foreign minister, Count Johann Hartwig Ernst von Bernstorff (1712–72), who served Frederick in that capacity from 1751 until 1770. Frederick was a patron of learning. He founded a military academy in Sorø, Denmark, and established schools in Bergen and Trondheim, Norway, for the education of Laplanders. In Copenhagen he established academies of printing and sculpture. During his reign, trade in Asia and the Americas was stimulated and the national wealth was increased.

Frederick VI (1768–1839). See FREDERICK VI, King of Denmark.

Frederick VII (1808–63), King of Denmark (1848–63), son of Christian VIII (see under CHRISTIAN). In 1849 Frederick promulgated the Unionist constitution abolishing the principle of absolute royal power. During most of his reign Denmark was involved in the Schleswig-Holstein (q.v.) disputes with Germany and Austria.

Frederick VIII (1843–1912), King of Denmark (1906–12), born in Copenhagen, and educated at the University of Oxford. He succeeded to the throne on the death of his father, Christian IX (see under CHRISTIAN). Frederick's son Christian became Haakon VII (q.v.), King of Norway, in 1905. Frederick was a brother of Alexandra, Queen Consort of Great Britain, and of George I (qq.v.), King of Greece.

Frederick IX (1899–1972). See FREDERICK IX, King of Denmark.

GERMANY

One emperor and four kings of Germany were named Frederick. Three of the kings, Frederick I, II, and IV, were also Holy Roman Emperors. Frederick III, King of Prussia, was simultaneously Emperor of Germany.

Frederick III (1831–88). See FREDERICK III, King of Prussia and Emperor of Germany.

Frederick I (1123?–90). See FREDERICK I, Holy Roman Emperor.

Frederick II (1194–1250). See FREDERICK II, Holy Roman Emperor.

Frederick III (1286?–1330). See FREDERICK III, King of Germany.

Frederick IV (1415–93). See FREDERICK III, Holy Roman Emperor.

HOLY ROMAN EMPIRE

Frederick I (1123?–90). See FREDERICK I, Holy Roman Emperor.

Frederick II (1194–1250). See FREDERICK II, Holy Roman Emperor.

Frederick III (1415–93). See Frederick III, Holy Roman Emperor.

NORWAY

The six kings named Frederick were also the first six kings of Denmark. See under *Denmark*, above.

PRUSSIA

Frederick I (1657–1713). See FREDERICK I, King of Prussia.

Frederick II (1712–86). See FREDERICK II, King of Prussia.

Frederick III (1831–88). See FREDERICK III, King of Prussia and Emperor of Germany.

SICILY

Frederick I (1194–1250). See FREDERICK II, Holy Roman Emperor.

Frederick II (1272–1337). See FREDERICK II, King of Sicily.

Frederick III, called THE SIMPLE (1341–77), King of Sicily (1355–77), and member of the Sicilian branch of the Aragonese dynasty. To preserve the independence of his kingdom he continued the war against Naples begun during the reign of Frederick II (q.v.), King of Sicily. The war was ended in 1372 by agreement with Joanna I, Queen of Naples (1343–82). Frederick retained control of Sicily until his death.

SWEDEN

Frederick I (1676–1751). See FREDERICK I, King of Sweden.

THE TWO SICILIES

Frederick (1452–1504), King of the Two Sicilies (1496–1501), son of Ferdinand I, King of Naples (see under FERDINAND), succeeding his nephew Ferdinand II, King of Naples, in 1496.

WÜRTTEMBERG

Frederick I, in full FREDERICK WILLIAM CHARLES (1754–1816), King of Württemberg (1806–16). As Frederick II he was Duke of Württemberg from 1797 to 1805. He fought against France during the early phase of the Napoleonic Wars (q.v.) and lost part of his duchy in 1801. Frederick later supported Napoleon I (q.v.), Emperor of France, who by 1805 restored to Frederick the lost territory and increased the size of his dukedom. With Napoleon's permission, Frederick proclaimed himself King Frederick I in 1806. After Napoleon's defeat at Leipzig (q.v.) in 1813, Frederick joined the allied coalition against France.

FREDERICK III (Dan. *Frederik III*) (1609–70), King of Denmark and Norway (1648–70), born in Haderslev, Denmark, the son of Christian IV (see under CHRISTIAN), King of Denmark and Norway. Between 1623 and 1634 he held several important church positions, including the archbishopric of Brømen (1634). He became king in 1648 after he signed a charter further restricting the royal power. In 1657 Frederick began a war against Sweden to regain provinces lost before his accession to the throne. He was defeated and in 1658 signed the Treaty of Roskilde, ceding a portion of Norway and some Danish islands to Sweden. Shortly after the conclusion of peace the Swedes reopened the war and besieged Copenhagen. With aid from the German region of Brandenburg (q.v.) the Danes expelled the Swedes from the Jylland (Jutland) Peninsula. In 1660, however, deserted by his allies, Frederick was obliged to make peace, relinquishing all claims to the territories possessed by Denmark in Swedish Scandinavia. In that year both the commons and the clergy agreed to the transformation of the kingship from an elective to an absolute and hereditary monarchy.

FREDERICK VI (Dan. *Frederik VI*) (1768–1839), King of Denmark (1808–39) and King of Norway (1808–14), born in Copenhagen, Denmark, the son and successor of Christian VII (see under CHRISTIAN). He was made head of the state council in 1784, when his father became insane, and acted as regent until Christian's death in 1808. Aided by Count Andreas Peter Bernstorff (1735–97), Frederick instituted such reforms as civil rights for Jews, the abolition of the slave trade, and freedom of the press. In 1800, because of British failure to respect the rights of free ships during the French Revolution (q.v.), Frederick joined the armed neutrality of the northern European states formed against Great Britain by Russia, Sweden, and Prussia. As a result, all Danish vessels in British ports were seized; in the next year, when Frederick refused to withdraw from the neutrality convention, the Danish fleet was virtually destroyed by the British navy under Lord Horatio Nelson (q.v.). Because Frederick continued to stand firm against the British, during the Napoleonic Wars (q.v.), although Denmark remained neutral, the British bombarded Copenhagen in 1807. In that year Frederick became an ally of Napoleon I (q.v.), Emperor of France. When Napoleon was defeated in 1814, Frederick was compelled to cede Norway to Sweden. The war left his country bankrupt, and Frederick devoted several years to the restoration of financial order. Toward the end of his reign he yielded to the demand for

FREDERICK (Denmark)

constitutional government and consented to the establishment of provincial councils.

FREDERICK IX (Dan. *Frederik IX*), in full CHRISTIAN FREDERIK FRANZ MICHAEL KARL GEORG (1899–1972), King of Denmark (1947–72), son and successor of King Christian X (see *under* CHRISTIAN), born near Copenhagen. Frederick was educated at the Danish Naval Academy and the University of Copenhagen. He broke the Danish royal tradition by choosing a naval, instead of a military, career. During the German occupation of Denmark in World War II, Frederick was virtually interned in the palace. Crown Princess Margrethe (1940–), his eldest daughter succeeded him as Margrethe II.

FREDERICK III (Ger. *Friedrich III*), also known as FREDERICK OF AUSTRIA and called FREDERICK THE FAIR or FREDERICK THE HANDSOME (1286?–1330), King of Germany (1314–22). The son of Albert I of Austria, King of Germany (1250?–1308), Frederick became Duke of Austria in 1306 and was elected King of Germany by a minority of electors in 1314. Because the majority of electors favored Louis IV, Duke of Bavaria (see Louis IV, Holy Roman Emperor and King of Germany), the latter resorted to war against Frederick. Frederick was captured in 1322 after eight years of conflict and was imprisoned. He was released on his recognition of Louis as co-ruler in 1325. Frederick's brother Leopold I, Duke of Austria and Styria (1290?–1326), refused to recognize Louis' claim as king, however, and as a result Frederick, who had promised Louis that he would win Leopold's support for the co-rulership, voluntarily returned to prison.

FREDERICK I (Ger. *Friedrich I*), called FREDERICK BARBAROSSA (1123?–90), Holy Roman Emperor and King of Germany (1152–90), King of Italy (1155–90), and as Frederick III, Duke of Swabia (1147–52; 1167–68), born in Waiblingen, Germany. He was the son of Frederick II of Hohenstaufen, Duke of Swabia (1090–1147), and the nephew of Conrad III (see *under* CONRAD), King of Germany. Conrad III, favoring Frederick over his own son, on his deathbed recommended to the German princes that Frederick be chosen for the German kingship and the imperial throne. Accordingly, after the death of his uncle in 1152, Frederick Barbarossa was made German king and elected Holy Roman Emperor. He conceived of his imperial title as a grant from God, through the German princes, and wished to restore the glory of the Roman Empire. He consequently decided to consolidate the imperial position in Germany and Italy, and began by issuing a general order for peace among the princes of Germany, at the same

time granting them extensive concessions. In 1154 he proceeded to Italy, where he received the Lombard crown at Pavia (see LOMBARDS). The following year he was crowned Holy Roman Emperor by Pope Adrian IV (see *under* ADRIAN), whose authority Frederick had reinstated before his coronation.

In 1156 Pope Adrian aroused Frederick against the papacy by implying in a letter to Frederick that the emperor held lands only as a fief from the pope. Two years later Frederick incurred the



Emperor Frederick I, called Frederick Barbarossa.

hostility of the Lombards by demanding recognition of all his royal rights, including his power to appoint the imperial *pōdestà*, or governor, in every town. Such cities as Milan, Piacenza, Brescia, and Crema considered that demand to be a denial of their communal liberties, and in 1158 began a struggle that lasted until 1183 and required Frederick to lead five expeditions to Italy. Between 1158 and 1162 Frederick warred with Milan and its allies, subduing that city and confirming claims to other Italian cities. Meanwhile Frederick had set up a series of antipopes in opposition to the reigning pope, Alexander III (see *under* ALEXANDER), who espoused the cause of the Milanese and their allies and who, in 1165, excommunicated Frederick. By attacking the Leonine City in Rome in 1167–68, Frederick was able to install one of the antipopes, Paschal III (d. 1168), on the papal throne. The Lombard League (q.v.), consisting of the cities of Milan, Parma, Padua, Verona, Piacenza, Bologna, Cremona, Mantua, Bergamo, and Brescia, was formed in 1167 and eventually acknowledged Pope Alexander as leader. During the

next seven years the league acquired military strength, rebuilt Milan, constructed the fortress city of Alessandria, and organized a federal system of administration. The fifth expedition (1174–76) of Frederick to Italy terminated in defeat by the Lombard League at Legnano. The defeat was significant in military history because it was the first major triumph of infantry over a mounted army of feudal knights. Frederick was forced in 1177 to acknowledge Alexander III as pope and in 1183 to sign the Peace of Constance, acceding to the demands of the Lombards for autonomy but retaining imperial suzerainty over the towns.

Although imperial control in Italy was virtually ended by his defeat at Legnano, Frederick managed to enhance his prestige in Central Europe. He made Poland tributary to the empire, raised Bohemia to the rank of a kingdom, and erected the Margraviate of Austria into an independent hereditary duchy. His own power as emperor in Germany was firmly established in 1180, when he ended his long struggle with the Welfs (see GUELPHS AND Ghibellines) by putting down a revolt led by the Welf Henry the Lion (q.v.) and depriving him of most of his lands.

Frederick initiated the Third Crusade in 1189, and in the next year, having resigned the government of the empire to his son Henry VI (q.v.), Holy Roman Emperor, set out for Asia Minor. After gaining two great victories over the Muslims at Philomelion (now Akşehir) and Iconium (now Konya), he was drowned in the Calycadnus (now Goksu) R. in Cilicia (now in Turkey) in 1190. See *CRUSADES: Third Crusade* (1189–92).

FREDERICK II (Ger. *Friedrich II*) (1194–1250), Holy Roman Emperor (1215–50) and as Frederick I, King of Sicily (1198–1212), born in Iesi, Italy, son of Emperor Henry VI and grandson of Frederick I (q.v.), Holy Roman Emperor. He was made German king in 1196 and on the death of his father two years later became king of Sicily. When his mother, Constance of Sicily (1146–98), acting as regent, died several months later, the four-year-old prince was placed under the guardianship of Pope Innocent III (see under *INNOCENT*), the new regent of Sicily. Emperor Otto IV (see under *OTTO*) was deposed in 1211, and the German princes selected Frederick to replace him. A contest for the imperial throne ensued, because Otto was unwilling to relinquish the crown. Supported by the papacy, to which he promised many concessions, and aided by the French, Frederick was eventually secured in his title. He was crowned king of Germany at Aix-la-Chapelle (now Aachen, West Germany) in

1215 and Holy Roman Emperor at Rome in 1220.

On his coronation Frederick made a number of elaborate promises to the Church, including a vow that he would go on a Crusade. He postponed the Crusade, however, because anarchy was rampant in Sicily at that time. An additional factor was the refractory conduct of the Lombard cities, which in 1226 renewed the Lombard League (q.v.), originally formed against Frederick I. The following year Frederick annulled the Treaty of Constance (see GUELPHS AND Ghibellines) and put the Lombard cities under the ban of the empire. Threatened several times with excommunication if he did not fulfill his coronation pledge, Frederick determined to sail for Jerusalem in 1227. An epidemic forced him to return three days after his departure, whereupon Pope Gregory IX (1147?–1241) declared him excommunicated. In 1228 Frederick led the Fifth Crusade to the Holy Land, where he took Jerusalem and concluded a ten-year truce with the sultan of Egypt; see *CRUSADES: Fifth Crusade* (1228–29). Having married Yolande (d. 1227), daughter of the titular king of Jerusalem, John of Brienne (q.v.), and having assumed that title on her death in 1227, Frederick was crowned king of Jerusalem in that city in 1229.

He returned to Europe and spent many of his remaining years attempting to bring the Lom-

Frederick II, Holy Roman Emperor, an illustration from his work on the art of falconry. Bettmann Archive



FREDERICK (Holy Roman Empire)

bards under subjection. During intermittent struggles with the papacy he was excommunicated twice again, by Pope Gregory IX in 1239 and in 1245 by Pope Innocent IV (d. 1254). His participation in costly wars in Italy caused him to neglect the welfare of his German subjects. Frederick managed to establish peace, prosperity, and order in Sicily, however, promulgating there in 1231 a comprehensive code of laws, described as the best issued by any Western ruler since the reign of Charlemagne (q.v.), Holy Roman Emperor. Frederick also made worthy contributions to learning in Italy. Because he was a man of culture, he gathered scholars and men of letters at his Sicilian court, which the Italian poet Dante Alighieri (q.v.) called the birthplace of Italian poetry. The University of Naples was founded by Frederick in 1224. For about a century after his death the belief persisted that Frederick was still alive. According to one famous legend, Frederick resides in a cave in the Kyffhäuser Mt., in the region of Thuringia (q.v.), awaiting the summons of the German people to return and restore peace in the empire. The legend was later interpreted to refer to Frederick I.

FREDERICK III (Ger. *Friedrich III*) (1415–93), Holy Roman Emperor (1440–93), as Frederick IV, King of Germany (1440–86), and as Frederick V, Archduke of Austria (1440–93). He was born in Innsbruck, Austria, the son of Ernest of Hapsburg, Duke of Styria and Carinthia (1377–1424). In 1440 Frederick was elected Holy Roman Emperor and king of Germany, succeeding Albert II (1397–1439), who had died a few months earlier. He was made guardian of Albert's posthumous son, Ladislas V (1440–57). In 1452 he was crowned Holy Roman Emperor in Rome, the last time an emperor was crowned in that city. By the Concordat of Vienna, which Frederick signed in 1448, he received the support of the papacy in securing the crown of the Holy Roman Empire and, in return, guaranteed the fidelity of the Germans to Rome. Because in this document he sacrificed the liberty that the German Church had obtained earlier at the Council of Basel (see **BASEL, COUNCIL OF**), Frederick incurred the disfavor of the German princes. Frederick was an uninterested and incapable ruler. He did not attend the sessions of the imperial diets, he ignored revolts in Austria and Hungary in 1451, and he failed to take decisive action against the Turks, who were menacing the frontiers of the empire. He lost his authority in Switzerland in 1448, and when his ward Ladislas died in 1457, he was unable to secure the kingships of Bohemia and Hungary. For several

years he was barred from Lower Austria by his brother Albert VI, Duke of Styria and Carinthia (1418–63) but he regained control of that territory and united it with Upper Austria on the death of his brother in 1463. After that date his Austrian possessions were frequently invaded and devastated by armed forces under George of Poděbrad (1420–71), King of Bohemia, and Matthias Corvinus (q.v.), King of Hungary; the latter captured and occupied Vienna in 1490. In 1477 Frederick arranged the marriage of his son and successor, Maximilian (see **MAXIMILIAN I**), to Mary of Burgundy (1457–82), thereby increasing the wealth and power of the Hapsburg family. When in 1486 Maximilian was elected German king, Frederick resigned the government to his son and settled in Linz, where he devoted himself to the study of sciences.

FREDERICK I (Ger. *Friedrich I*) (1657–1713), first King of Prussia (1701–13), and as Frederick III, Elector of Brandenburg (1688–1701), son of Frederick William (q.v.), Elector of Brandenburg, born in Königsberg (now Kaliningrad, Russian S.F.S.R.). In 1674 he became heir to the electorate of Brandenburg (q.v.), and during his electorate, he endeavored to establish a court modeled on that of Louis XIV (q.v.), King of France. Frederick, who had for many years attempted to secure a royal title, finally acquired recognition as king of Prussia by providing Leopold I, Holy Roman Emperor (see *under* **LEOPOLD**) with troops in the War of the Spanish Succession; see **SPANISH SUCCESSION, WAR OF THE**. In 1701 Frederick crowned himself at Königsberg, expending vast sums of money on his coronation. Although he depleted the public treasury during his reign, he undertook some projects beneficial to the welfare of Prussia, such as the establishment in 1694 of the University of Halle and the founding in 1707 of the Academy of Sciences, Berlin. He patronized scholars, including the German philosopher and mathematician Baron Gottfried Wilhelm von Leibniz (q.v.), and encouraged persecuted Protestants from other countries to settle in Prussia.

FREDERICK II (Ger. *Friedrich II*), known as **FREDERICK THE GREAT** (1712–86), King of Prussia (1740–86), son of King Frederick William I and grandson of Frederick I (qq.v.), born in Berlin. As crown prince he was trained, under his father's supervision, to become a soldier and a thrifty administrator. Frederick, however, encouraged by his mother, Sophia Dorothea of Hannover (1666–1726), and his tutors, showed a preference for courtly life, music, and French literature. Frederick William, failing to understand the tastes of his son, developed an open dislike



Frederick the Great, a rendering by the German painter Adolph Friedrich Erdmann von Menzel (1815–1905).

German Information Center

for Frederick. At the age of eighteen, Frederick decided to escape to England; his proposed plan was discovered, and he was arrested, imprisoned, temporarily deprived of his status as crown prince, and forced to witness the execution of one of his two confederates. After he had subsequently applied himself diligently to fiscal and military affairs and had consented to a marriage in 1733 with Elizabeth Christine (1715–97), daughter of Ferdinand Albert II of Brunswick (1680–1735) Frederick was reinstated to his position as crown prince. He then went to live for seven years on his estate at Rheinsburg, where, in his leisure time, he studied philosophy, history, and poetry, and corresponded with the French philosophers, notably Voltaire (q.v.). In his *Antimachiavelli*, written during that period and published by Voltaire in 1740, Frederick idealistically opposed the political doctrines of the Italian statesman and philosopher Niccolò Machiavelli (q.v.), favoring peaceful and enlightened rule.

On the death of his father in 1740 Frederick became king, and embarked almost immediately on a policy of Prussian aggrandizement. When Maria Theresa (q.v.) became archduchess of Austria in that same year, Frederick demanded the cession of duchies of Silesia (q.v.) in return for Prussian recognition of the Pragmatic Sanction (q.v.), which gave the Austrian

Hapsburg (q.v.) dominions to Maria Theresa. Refused by Austria, Frederick invaded Silesia, commencing the War of the Austrian Succession (see SUCCESSION WARS). He led his forces to victory at Mollwitz in 1741 and at Chotusitz in 1742; in the latter year, by the Treaty of Breslau, Maria Theresa was obliged to yield the Silesian territory demanded by Prussia. Frederick acquired East Friesland (now a region of Germany) in 1744, on the death of the last ruler without heirs of that principality, and in 1745 he fought and won a second war with Austria, terminated by the Peace of Dresden, which assured Prussia the possession of Silesia.

By this time Frederick was recognized as an able military leader, and the position of Prussia in Europe had risen considerably. The military greatness of Frederick was demonstrated during the Seven Years' War (q.v.) from 1756 to 1763. Frederick and his forces, aided only by financial assistance from Great Britain, which was at war with France, opposed the armies of Austria, Russia, Sweden, Saxony, and France. The Peace of Hubertusburg in 1763 awarded Prussia no new territory, as it merely confirmed the boundaries that had existed before the war; however, at the end of the war Prussia was established as a rival to Austrian domination of the German states. Frederick made an alliance with Catherine II (q.v.), Empress of Russia, in 1764, and by the first partition of Poland in 1772 he received Polish Prussia, exclusive of Gdańsk (Danzig) and Toruń (Thorn), thus uniting the regions of Brandenburg and Pomerania (qq.v.). By the Treaty of Teschen in 1779, after the War of the Bavarian Succession, a short conflict with Austria, Prussia was awarded the Franconian principalities of Bavaria (q.v.); Austria retained only a part of Lower Bavaria. A further step was made toward destroying Austrian dominance in 1785, when Frederick gathered the German princes into a union of princes, the *Fürstenbund*, to preserve the constitution of the Holy Roman Empire.

Frederick was extremely sympathetic to the American Revolution and was an admirer of the American Revolutionary soldier and statesman, and first President of the United States, George Washington (q.v.). Frederick was one of the first sovereigns to conclude a commercial treaty with the U.S. He did not, however, limit his activities to the international scene; internal affairs flourished during his reign. His rule was absolute; he was a ubiquitous administrator, constantly checking the work of his officials, from whom he exacted the utmost in conscientiousness. He is considered among the most no-

FREDERICK (Prussia)

table of benevolent despots. Under his rule new methods of agriculture and manufacturing were introduced. Marshes were drained, providing new lands for cultivation and colonization and the institution of serfdom, while not abolished, was somewhat liberalized. Under Frederick's personal supervision the efficiency and size of the army were increased. He reviewed the troops frequently, concerned himself with the discipline of his officers and men, and wrote works for his generals on the science of warfare. In 1747 Frederick, who was particularly interested in the equitable distribution of justice to all classes, issued a new codification of Prussian law, the *Codex Fridericianus*.

Frederick continued to patronize the arts and sciences throughout his life. The Academy of Sciences again became an important center of learning during his reign, and elementary education progressed as under no previous Prussian sovereign. In his favorite residence, the palace of Sans Souci, Frederick held court, but always entertained with judicious economy. Contemptuous of the German language and culture, Frederick spoke French at court and patronized French writers, many of whom, including Voltaire, paid him visits in Berlin. Frederick himself was a musician, spending many hours with his flute. He was also a prolific writer; his complete works were published in thirty volumes between 1846 and 1857.

FREDERICK III (Ger. *Friedrich III*) (1831–88), King of Prussia and Emperor of Germany (March 9–June 15, 1888), son of William I (q.v.), King of Prussia and Emperor of Germany, born in Potsdam (now in East Germany). When his father succeeded to the throne of Prussia in 1861, Frederick became Frederick William, Crown Prince of Prussia. Liberal in his political views, he opposed Prince Otto Eduard Leopold von Bismarck (q.v.) throughout the ministry of the latter. Although opposed to war with Austria in 1866, Frederick became commander of an army and led the Prussian forces to victory at the Battle of Sadowa, which terminated the Seven Weeks' War (q.v.). During the Franco-German War (q.v.) of 1870–71 he commanded the armies of the southern German States, participating in the battles of Wörth and Sedan and the siege of Paris.

A man of learning and culture, Frederick patronized art and literature and encouraged the work of the royal museums. As Crown Prince Frederick William, he was genially called "Our Fritz" by the German people, most of whom anticipated with pleasure his accession to the throne. Frederick became ill, however, in 1887

and lived only three months after succeeding to the throne on his father's death in 1888.

FREDERICK II (Ital. *Federigo II*) (1272–1337), King of Sicily (1296–1337), also called by himself Frederick III because he was the third son of Pedro III, King of Aragón (1236–85), Frederick became regent of Sicily in 1291, when his brother James became James II (q.v.), King of Aragón. In concluding a war with the Angevin rulers of Naples in 1295, James surrendered the island of Sicily to the Church, which placed it under the administration of the Angevins (see ANJOU, HOUSES OF). The Sicilians subsequently revolted, choosing Frederick as their leader and crowning him king in 1296. Pope Boniface VIII (see under BONIFACE) tried to persuade Frederick to relinquish the Sicilian throne, but the latter refused, and war ensued between the Sicilians and the Angevins. The war was indecisive. In 1302, according to the terms of the Treaty of Caltabelotta, Frederick was given possession of Sicily until his death, at which time the island was to revert to Angevin control. In 1313 Frederick entered into an alliance with Henry VII (q.v.), King of Germany and Holy Roman Emperor, and again went to war with the Angevins, fighting them intermittently throughout the rest of his reign. From 1321 until 1335 Frederick was under excommunication from the Church. Under his rule the Sicilians were welded into a united nation. Despite the Treaty of Caltabelotta, Frederick's son Peter (r. 1337–42) acquired Sicily on the death of his father.

FREDERICK I (1676–1751), King of Sweden (1720–51), born in Kassel, Germany. He was a landgrave or count of Hesse-Kassel in 1715 when he married Princess Ulrika Eleonora (1688–1741), the sister of Charles XII (q.v.), King of Sweden. In 1718 Ulrika succeeded to the throne, and two years later she abdicated in favor of Frederick. His royal powers were sharply limited by a new constitution that granted increased legislative powers to the Riksdag or parliament and vested executive power in a committee of aristocrats. The aristocracy was, however, divided into two factions: the Caps, who sought a conciliatory foreign policy, and the Hats, who wanted to regain territory lost to Russia during the reign of Charles. In 1738 the Hats gained a political majority, and from 1741 to 1743 Sweden was at war with Russia. Sweden lost additional territory in Finland, and Russian influence was extended into Sweden. Frederick was succeeded by Adolphus Frederick of Holstein-Gottorp (1710–71), the choice of Elizabeth Petrovna (q.v.), Empress of Russia.

FREDERICK AUGUSTUS, name of three kings of Saxony.

Frederick Augustus I, called **FREDERICK AUGUSTUS THE JUST** (1750–1827), first king of Saxony (1806–27), and as Frederick Augustus III, Elector of Saxony (1763–1806), born in Dresden. He aided Frederick II (q.v.), King of Prussia, known as Frederick the Great, against Austria in 1778–79 during the War of the Bavarian Succession (see **SUCCESSION WARS**). Attempting to establish his neutrality, Frederick Augustus declined the Polish throne in 1791, but cooperated with the other European powers against France from 1792 to 1806; see **FRENCH REVOLUTION**; **NAPOLEONIC WARS**. Following a French victory at Jena (q.v.) in 1806, Frederick Augustus made peace with Napoleon I (q.v.), Emperor of France. Under terms of the treaty, signed at Posen (now Poznań), Frederick Augustus became king of Saxony, and Saxony joined the Confederation of the Rhine (q.v.). His alliance with Napoleon proved costly. The Congress of Vienna, meeting in 1814–15 after the Napoleonic Wars, awarded the northern portion of Saxony to Prussia; see **VIENNA, CONGRESS OF**. In 1815, Frederick Augustus led Saxony into the newly formed German Confederation, and Saxony was thereafter largely eclipsed by Prussia. Frederick Augustus was succeeded as king by his brother Anthony (r. 1827–36).

Frederick Augustus II (1797–1854), King of Saxony (1836–54), nephew of King Frederick Augustus I and King Anthony, born in Dresden. As joint regent with Anthony from 1830 to 1836, he was partly responsible for the reforms in the Saxony constitution of 1831. After he became king in 1836, however, his reign was disturbed by demands for additional political and social reforms. In 1849 he refused to accept the liberal German constitution that was written in Frankfurt, and the ensuing riots in Dresden had to be quelled by Prussian troops. Thereafter the king largely withdrew from the affairs of state. He was succeeded as king by his brother John (see *under* **JOHN: Saxony**).

Frederick Augustus III (1865–1932), last King of Saxony (1904–18), son of King George (1826–1904), and grandnephew of Frederick Augustus II, born in Dresden. His reign was beset by the constitutional conflict stemming from an 1896 electoral law that prevented proportionate representation (q.v.) in both the Saxon and imperial German diets. On Nov. 9, 1918, at the end of World War I, a revolution broke out and he was forced to abdicate. He spent the rest of his life in commercial enterprises.

FREDERICK HENRY (1584–1647), Prince of Orange and Stadholder of the Dutch Republic

(1625–47), son of William I (q.v.), known as the Silent, born in Delft. He was given strong military training by his brother, Maurice of Nassau (1567–1625), whom he succeeded as stadholder (a powerful governor or viceroy) of the United Provinces of the Netherlands in 1625. As stadholder he prosecuted the war against Spain, making alliances successively with Denmark, Sweden, and France. Under his generalship many cities were taken from the Spanish, among them Hertogenbosch (1629), Maastricht (1632), Breda (1637), and Hulst (1645). Finally, in 1646, he started peace negotiations with Spain. The resulting treaty, concluded in 1648, after his death, accorded the United Provinces all the advantages for which they had been fighting during the preceding eighty years.

Frederick Henry reigned during the Golden Age of the Dutch Republic. The republic was at the height of its powers and suffered little political or religious conflict. Culture flourished, producing painters such as Rembrandt and Frans Hals (qq.v.), and commerce expanded with the establishment of colonies in the Far East and the conquest of territory in South America. See **NETHERLANDS, THE: History**.

FREDERICKSBURG, city of Virginia, in Spotsylvania Co., of which it is politically independent, at the head of navigation on the Rappahannock R., and 54 miles N. of Richmond, and 50 miles sw. of Washington, D.C. It is served by railroad and is the commercial center of a fertile agricultural area where corn and wheat are grown. The principal industries in Fredericksburg are the manufacture of clothing, shoes, hosiery, confectionery, cellophane, wrapping paper, chairs, and metal products. The city is the site of Mary Washington College for women, a branch of the University of Virginia; see **VIRGINIA, UNIVERSITY OF**.

Fredericksburg has many historic associations with the American Civil War; see **FREDERICKSBURG, BATTLE OF**. The historic sites in the city and vicinity are enclosed by the Fredericksburg and Spotsylvania County Battlefields Memorial National Military Park, established in 1927, and include the sites of the battles of Chancellorsville, Fredericksburg, Spotsylvania Court House, and the Wilderness (qq.v.) as well as the Jackson Shrine, at the spot where General Thomas Jonathan ("Stonewall") Jackson (q.v.) died. Fredericksburg National Cemetery is nearby.

The site of Fredericksburg was visited by the English adventurer and American colonizer John Smith (1580–1631) in 1608; the first settlement was established in 1671. The town was founded in 1727 and named in honor of Frederick Louis,

FREDERICKSBURG, BATTLE OF



The Union army assault on Fredericksburg, Va., depicted in a contemporary engraving. Clarence Hornung

Prince of Wales (1707–51). It had an extensive maritime commerce with England for many years. Fredericksburg suffered heavily during the Civil War. In 1879 it was incorporated as an independent city. Pop. (1960) 13,639; (1970) 14,450.

FREDERICKSBURG, BATTLE OF, one of the early important battles of the American Civil War (see CIVIL WAR, THE AMERICAN), fought in and near Fredericksburg, Va., from Dec. 13 to 15, 1862. The contending forces were the Union Army of the Potomac with 122,000 troops and 312 guns, under Ambrose Everett Burnside (q.v.), and the Confederate Army of Northern Virginia with 78,500 men and 270 guns, commanded by Robert E. Lee (see under LEE). After the Battle of Antietam (see ANTIETAM, BATTLE OF) in September, 1862, Lee withdrew from Maryland to Virginia, and the Union government decided that a counteroffensive was strategically in order. Burnside intended to cross the Rappahannock R. at several points, and to encircle and capture Fredericksburg as a preliminary to launching the general offensive against the Confederate army. The Union crossing of the Rappahannock was held up, however, because of a delay in shipment of the pontoon train necessary to the crossing. In the interim, Lee, who had at first decided to await the Union forces at a point 36 miles s. of Fredericksburg, moved to the Rappa-

hannock and fortified the heights commanding the river. The Union army crossed the Rappahannock directly opposite Fredericksburg and launched frontal assaults against the Confederate troops. The attacks were repulsed by the Confederates and the defeated Union army was compelled to withdraw to Falmouth, Va. Union losses were 1284 killed, 9600 wounded, and 1769 missing; Confederate losses were 595 killed, 4061 wounded, and 653 missing. See also FREDERICKSBURG.

FREDERICK WILLIAM I (1688–1740), King of Prussia (1713–40), son of King Frederick I and father of Frederick II (qq.v.), born in Berlin. He succeeded his father in 1713 and for the next seven years was involved in a dispute with Sweden over Pomerania (q.v.), a part of which he finally received through the Treaty of Stockholm in 1720. By recognizing, in 1726, the Pragmatic Sanction (q.v.), by which Maria Theresa (q.v.), Archduchess of Austria, was given the Austrian Hapsburg (q.v.) dominions, he was granted the succession to the Lower Rhine duchies of Jülich and Berg.

Frederick William's greatest accomplishments were in the internal development of Prussia. Contemptuous of the luxury of his father's reign, he instituted a system of rigid and efficient economy at court and transferred public financial administration from local governments to the central royal authority. He was thus able to repay the debts incurred by his father and to

greatly improve the financial condition of Prussia. He built up industry by forbidding the importation of finished goods and the exportation of raw materials, and directed the colonization of nonpopulous areas, especially in East Prussia. The development of the army was his fondest achievement; he was particularly proud of the Potsdam Guard, composed of exceptionally tall men hired, and sometimes kidnapped, from all parts of Europe. Under his supervision the number of soldiers in the army was increased from about 38,000 to about 83,500, and Prussia became the third-ranking military power in Europe; see *ARMY: Transitional Period*. Although Frederick William was suspicious of higher education, he established many village schools and instituted compulsory elementary education.

FREDERICK WILLIAM II (1744–97), King of Prussia (1786–97), grandson of Frederick William I and nephew of Frederick II (qq.v.), born in Berlin. He succeeded to the throne in 1786 upon the death of his uncle. In 1792 he made an alliance with Leopold II, Holy Roman Emperor (see under *LEOPOLD*), to support Louis XVI (q.v.), King of France, in the French Revolution. As a result of Frederick's participation in the ensuing wars, he was forced in 1795 by the Treaty of Basel to cede to France Prussian territories west of the Rhine R. He secured territory from Poland, however, by participating in the Polish partitions of 1793 and 1795. Influenced during his reign by the Rosicrucian Order (q.v.), of which he was a member, he suppressed the ideas of the Enlightenment (q.v.), imposing censorship on religion, education, and the press. He lacked interest in military affairs and allowed a supreme college of war to supervise the army, which declined markedly during his reign. Through his own ineptitude and that of the favorites he appointed to administrative positions, the treasury of Prussia was bankrupted and the reputation of the country diminished by the end of his reign.

FREDERICK WILLIAM III (1770–1840), King of Prussia (1797–1840), son of Frederick William II (q.v.), born in Potsdam. He was given military training in his youth and from 1792 to 1794 fought against France during the French Revolution (q.v.). In 1797 he succeeded to the throne and set about rebuilding the economy and the army, which had suffered during the reign of his father. He maintained the neutrality of Prussia in the Napoleonic Wars (q.v.) until 1805, when, persuaded by Russia and the aroused spirit of his people, he joined the allies against France. Prussia was defeated at Jena and Auerstedt in 1806. By the Treaty of Tilsit in 1807, various

Prussian territories were ceded to France; see *TILSIT, TREATY OF*. Through the efforts of the administrators Baron Heinrich Friedrich Karl vom und zum Stein, Count August Neithardt von Gneisenau, Prince Karl August von Hardenberg (qq.v.), and Gerhard Johann David von Scharnhorst (1755–1813), the Prussian army was reconstituted between 1807 and 1812, and participated in the victorious campaigns against Napoleon I (q.v.), Emperor of France, from 1813 until 1815. In this period Frederick William promised the Prussian people a constitution. At the close of the war in 1815, however, he joined the Holy Alliance (q.v.) and participated in the repression of liberal movements in Europe that resulted from the alliance. Within Prussia, he accomplished the reorganization of parts of the administrative system and consented to formation of the Zollverein, or customs union (q.v.). **FREDERICK WILLIAM IV** (1795–1861), King of Prussia (1840–61), son of Frederick William III (q.v.), born in Berlin. He gave indications of becoming a liberal monarch by increasing the freedom of religion and relieving press censorship on his accession to the throne in 1840. In 1847 he convened the United Diet, which, although limited, was a step toward a popular representative assembly. During the revolution that broke out in Prussia in 1848, he at first acceded to the demands of his people, promising a constitution and agreeing to become the leader of a united Germany. In 1849, however, he refused the imperial crown offered to him by the Frankfurt parliament. In the constitution granted the following year most of the governing power was vested in the king, suffrage was restricted, and membership in the parliament was considerably limited. After suffering two strokes of paralysis in 1857, Frederick William became mentally unfit to rule. In 1858 a regency was established under his brother William, who became king of Prussia as William I (q.v.) in 1861.

FREDERICK WILLIAM (Ger. *Friedrich Wilhelm*) (1620–88), Elector of Brandenburg (1640–88), called the Great Elector, son of Elector George William (d. 1640), born in Berlin, and educated at the University of Leiden. He succeeded his father to the electorate on the death of the latter in 1640. By remaining neutral from his accession until the end of the Thirty Years' War (q.v.), he was able to repair much of the damage inflicted by the war on his country during the reign of his father. In 1648 by the Peace of Westphalia ending the war, Prussia received several bishoprics and other small territories; see *WESTPHALIA, PEACE OF*. During the next

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thirty years Frederick William was able to acquire more lands and power for Brandenburg (q.v.) through participation in a series of alliances and wars. In 1656, during the war between Poland and Sweden, Frederick William became the ally of Sweden. In the following year, however, he changed his allegiance to Poland in return for recognition by that country of his suzerainty over the Duchy of Prussia, which had been until that time dependent on Poland. At the beginning of the Second Dutch War in 1672 Frederick William joined Holland, Spain, and the Holy Roman Empire against France. In 1673, however, after losing part of Clèves, he made peace with France, precluding the possibility of losing additional territory on the Rhine. He defeated the Swedes, who had invaded his lands, at Fehrbellin in 1675 and conquered western Pomerania; but because of the insistence of the ally of Sweden, Louis XIV (q.v.), King of France, Frederick William relinquished his claims to that territory at the Peace of Saint Germain-en-Laye in 1679.

Frederick William succeeded in centralizing the administration of government and rendered service to almost every province of public affairs, especially industry and commerce. After the revocation of the Edict of Nantes (q.v.) in 1685 he admitted to Prussia great numbers of Huguenots (q.v.), who, with the technological skill that they had already acquired in France, aided the development of Prussian industry. Frederick William directed the building of canals, the establishment of trading companies, and the founding of colonies in western Africa. Under his supervision the army was strengthened, and a navy was created. He was, in addition, interested in the encouragement of learning, founding the Royal Library in Berlin, and reorganizing the universities of Königsberg and Frankfurt-an-der-Oder.

FREDERICTON, city in Canada, capital of New Brunswick Province and county seat of York Co., on the Saint John R. about 55 miles N.W. of Saint John. The city is served by two railroads and by the Fredericton Municipal Airport. Fredericton is the commercial center of the interior of the province. Lumbering, mining, quarrying, and farming are the chief industries of the surrounding area. Industrial establishments in the city include lumber mills, tanneries, foundries, and factories for the manufacturing of woodworking machinery, boots and shoes, and lumber products. Fredericton is the site of the University of New Brunswick and its affiliate Saint Thomas University, New Brunswick Teachers College, and a research station of the De-

partment of Agriculture of Canada. The Provincial Parliament buildings contain portraits by the British artist Sir Joshua Reynolds (q.v.) and one of the few extant sets of the bird paintings of the American naturalist and artist John James Audubon (q.v.). Also in Fredericton is the Beaverbrook Art Gallery, which houses paintings by many well-known British and Canadian artists. Funds for the museum, as well as much of the collection, were donated by William Maxwell Aitken, 1st Baron Beaverbrook (q.v.), a British newspaper publisher.

History. Fredericton occupies the site of the old French village of Sainte Anne's Point, settled as early as 1731. In 1783, Loyalists from the United States settled there and renamed it in honor of Frederick Augustus (1763-1827), second son of King George III (q.v.) of Great Britain. In 1973, Fredericton was amalgamated with certain adjacent communities, doubling its land area and population. Pop. (1976) 45,248.

FREDERIKSBERG, residential area in Denmark, part of the city of Copenhagen. Frederiksberg is the site of an imposing palace, built by King Frederick IV (see *under* FREDERICK) in the first half of the 18th century. Industrial establishments in the city include the Royal Porcelain Works, a faience factory, and several breweries. Pop. (1970) 101,899.

FREE ASSOCIATION. See PSYCHOANALYSIS.

FREE CHURCH OF SCOTLAND, name commonly applied to the church established by the group of about 450 ministers who seceded from the Church of Scotland (see SCOTLAND, CHURCH OF) in 1843, thereby effecting a schism that came to be known as the Disruption. The basic issue in the split was the jurisdiction of the civil powers over the doctrines, discipline, and government of the church; it was brought to a head in 1838 by a decision of the civil courts that forbade any congregation to reject a pastor who had been appointed to serve it. This decision was upheld by the House of Commons (see PARLIAMENT) in March, 1843. The ministers, known as nonintrusionists, who opposed acceptance of this decision were led by Thomas Chalmers (q.v.). At the meeting of the General Assembly of the Church of Scotland, held in May, 1843, they declared their intention of separating from the church and immediately establishing a new one. They thereupon withdrew and organized the first Assembly of the Free Church of Scotland, of which Chalmers was elected moderator, or presiding officer. Except for its independent attitude toward the civil authorities and its voluntary renunciation of all claim to the parent church's properties and benefices, the seceding



A freedmen's primary school in Vicksburg, Miss., after the Civil War (from a contemporary magazine).

Library of Congress

group retained all the doctrines and practices of the Church of Scotland. The Free Church received such active and financial support from its adherents, who numbered about one third of the former members of the Church of Scotland, that by the end of 1847 more than 700 churches had been erected and the New College had been built in Edinburgh as an institution for theological studies. Similar institutions were later established in Aberdeen and Glasgow.

Between 1863 and 1873, unsuccessful efforts were made to create a union of the Free Church and the United Presbyterian Church; such a union was finally brought about in 1900, the new church being known as the United Free Church of Scotland. A small group within the Free Church refused to participate in the union, and declared itself the true Free Church. In October, 1929, the United Free Church and the Church of Scotland were reunited, under the latter name.

FREE CITY. See **CITY**.

FREEDMEN'S BUREAU, agency established as part of the United States War Department by an act of Congress in March, 1865. The full title of the agency was Bureau of Refugees, Freedmen,

and Abandoned Lands. The principal aim of the bureau was to provide assistance to the newly emancipated Negroes of the South after the Civil War (see **CIVIL WAR**, **THE AMERICAN**). Originally created for one year, the bureau was repeatedly continued by Congressional act; in 1866 the extension was effected over the veto of President Andrew Johnson (q.v.). The bureau was headed by a commissioner, General Oliver Otis Howard (q.v.), who was assisted by one assistant commissioner for each Southern State.

The bureau took responsibility for furnishing food and medical supplies to the Negroes, most of whom were destitute, and to needy whites as well. It was also concerned with the regulation of wages and working conditions of Negroes, the establishment and maintenance of schools for Negroes, most of whom were illiterate, and the control and distribution of lands abandoned by or confiscated from Southern proprietors. In addition, the bureau handled legal trials involving Negroes. The lands controlled by the bureau, totaling about 800,000 acres, were origi-

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nally intended to be distributed to former slaves and to persons of proved loyalty to the Union, in lots not exceeding 40 acres. For various reasons this plan was abandoned and much of the land was returned to the former owners, causing severe disappointment to the Negroes, who had hoped thereby to establish themselves as independent farmers. Most of the activities of the bureau were ended in 1869, except for the educational program which continued in effect until 1872 and effected the most significant achievements of the agency. Although it was denounced as an instrument of Northern politicians for economic and political advantage, accomplishments of the bureau include the establishment of a system of free public schools for Negroes, and of such outstanding educational institutions for Negroes as Howard, Fisk, and Atlanta universities, and Hampton Institute; the expenditure of about \$20,000,000 in various types of relief and assistance; and some improvements in the social, economic, and political status of Negroes in the South. See NEGROES IN THE UNITED STATES

FREEDOM. See LIBERTY.

FREEDOM OF RELIGION. See RELIGIOUS LIBERTY.

FREEDOM OF SPEECH. See SPEECH, FREEDOM OF.

FREEDOM OF THE PRESS. See PRESS, FREEDOM OF THE.

FREEDOM OF THE SEAS. See SEAS, FREEDOM OF THE.

FREE ENTERPRISE SYSTEM. See CAPITALISM.

FREE FRENCH, designation popularly applied to the armed forces of the French National Committee of Liberation, an organization founded in London, England, on June 28, 1940, following the capitulation of France to Germany in World War II (q.v.). The committee was established, on the initiative of General Charles André Joseph Marie de Gaulle (q.v.) for the purpose of carrying on the war against Germany. For an account of the activities of the Free French, later known as the Fighting French, see FRANCE: *History: Vichy Government and Resistance*.

FREEMAN, Douglas Southall (1886–1953), American historian, biographer, and editor, born in Lynchburg, Va., and educated at Richmond College and Johns Hopkins University. He was editor of the Richmond (Va.) *News-Leader* from 1915 to 1949, and visiting professor of journalism at Columbia University in 1934 and 1935 and professor from 1936 to 1941. His writings include *Virginia—A Gentle Dominion* (1924); the biography *R. E. Lee* (4 vol., 1934), which re-

ceived the 1935 Pulitzer Prize; and *Lee's Lieutenants* (3 vol., 1942–44). *George Washington: A Biography* (7 vol., 1948–54) appeared as a one-volume abridgement, *Washington*, in 1969.

FREEMAN, Mary Eleanor (1852–1930), American writer, born Mary Eleanor Wilkins in Randolph, Mass., and educated at Mount Holyoke Female Seminary (now Mount Holyoke College). Her earliest and finest writings, contained in the two collections of short stories *A Humble Romance* (1887) and *A New England Nun* (1891), reflect her keen observation of the spiritual frustrations engendered by the declining social structure of rural New England. She frequently contributed poetry and fiction to magazines, and was also the author of the play *Giles Corey, Yeoman* (1893); the novels *The Heart's Highway* (1900) and *The Portion of Labor* (1901); and the short-story collections *The Wind in the Rose Bush* (1903) and *Edgewater People* (1918).

FREEMAN, Orville Lothrop (1918–), American government official, born in Minneapolis, Minn., and educated at the University of Minnesota. After four years of service in the United States Marine Corps during World War II, Freeman returned to the university, receiving (1946) an LL.B. degree. He rose through the ranks of the Minnesota Democratic-Farmer-Labor Party until he was named (1948) State chairman. Freeman was governor of Minnesota (1955–61) and United States secretary of agriculture (1961–68) under Presidents John F. Kennedy and Lyndon B. Johnson. In 1970 he became president of Business International, a New York City publishing and consulting corporation.

FREEMASONRY, largest and most widely established fraternal order in the world; see FRATERNAL ORDERS. The masons' guilds were originally restricted to stonecutters, but with the completion of the building of the cathedrals in the 17th century, and especially in England during the Reformation (q.v.), they admitted as members men of wealth or social status. The guilds thus became societies devoted to general ideals, such as fraternity, equality, and peace, and their meetings became social rather than business occasions. Four or more such guilds, called lodges, united in London on June 24, 1717, to form a grand lodge for London and Westminster, which, within six years, became the Grand Lodge of England. This body is the "mother" grand lodge of Freemasons in the world, and from it all recognized grand lodges have derived. The Grand Lodge of All England was formed at York in 1725, that of Ireland at least by June of the same year, and of Scotland, in 1736. The York body came under the jurisdic-

tion of the Grand Lodge at London later in the century.

As a result of the patronage of the order by members of the nobility, the rising British mercantile class looked upon Freemasonry as an adjunct to social success, and the order became popular. The Masonic ideals of religious toleration and the basic equality of all men were in keeping with the growing spirit of liberalism during the 18th century. One of the basic tenets of the Masonic orders throughout the English-speaking world has been that religion is the sole concern of the individual. Opposition on the part of the Roman Catholic Church has been chiefly on the grounds that Freemasonry, with its binding principles and religious nature, has usurped the prerogatives of the Church. As a result of this opposition, the Freemasons have never been permitted in some strictly Catholic countries, such as Spain. In France, however, following the atheistical and Protestant trend of the French Revolution, the order flourished; in 1877, the Grand Orient of France went so far as to insist upon absolute freedom of conscience among the members of his lodge and to permit atheism. The other lodges, which had been founded upon the Christian beliefs of the early members, repudiated the Grand Orient. In 1894 they formed an independent grand lodge called the Grande Loge de France. In 1923 a third body, largely composed of English-speaking Masons, formed the Grande Loge Nationale Française.

Functions. In most English-speaking countries, the charitable and protective features of the fraternity have been responsible for the establishment of Masonic homes for the care of dependent aged Masons and their widows, and orphanages and schools for the children of members. The Mason is instructed that his fraternal obligations involving aid to members are to be subordinated to the duty he owes to God, his country, and his family, with full recognition of the duty he owes to his fellowmen. The Masonic fraternity differs radically from the other private, benevolent societies, and from the Independent Order of Odd Fellows, the next largest private, international, fraternal association, in that the relief or charity extended among members is purely voluntary, dependent on the need in each individual case; see ODD FELLOWS, INDEPENDENT ORDER OF. It is in no way part of a contract or other understanding that the distress of a brother shall call for specific financial recognition or care. Freemasonry is essentially an educational society, attempting to teach its members a moral philosophy of life.

Freemasons in America. The earliest of the

American lodges, founded by authority of the Grand Lodge of England, was the First Lodge of Boston, established in 1733, and one in Philadelphia, established about the same time. By the time of the Revolution there were about 150 lodges in colonial America. American Freemasons today comprise about three fourths of the total number of all members throughout the world, with (1968) 3,904,496 in the United States; world membership exceeds 6,000,000.

Scores of Masonic rites, all drawing their initiates from possessors of the first three symbolic degrees of entered apprentice, fellowcraft, and master Mason, have sprung up since the 17th century, but only five of any great consequence survive today.

Major Systems. There are two Masonic systems called "The York Rite" and "The Scottish Rite". Neither has any connection, historically or otherwise, with York, England or Scotland. The York Rite was formed in the late 18th century and is called "Capitular" and the members Royal Arch Masons (four degrees); the next step being "Cryptic" and the members Royal and Select Masons (three degrees); and the final step "Chivalric" and the members Knights Templar (three orders). The Scottish Rite was formed in Charleston, South Carolina, in 1801 (thirty-three degrees, including the three Symbolic Lodge Degrees). There are many other groups, loosely attached in some way to the York Rite, whose members are usually selected but sometimes elected. They are interested in special aspects of Masonry, including Masonic research. One might say they are off-shoots of the main stem. Among them are: The Royal Order of Scotland; The Allied Masonic Degrees; The Red Cross of Constantine; The Masonic Rosicrucian Society (S.R.I.C.F.); The Rite of Strict Observance (C.B.C.S.); The Grand College of Rites; Knight Masons; Order of Corks; The York Cross of Honour; The Blue Friars; The Holy Royal Arch Knight Templar Priests; and what might be called "fun degrees" such as The Shrine; the Grotto; and the Tall Cedars of Lebanon. Many of these are of considerable size. In addition there are some very small groups catering to students of special aspects of the Craft.

Opposition. Antimasonic sentiment occurred chiefly in two ways since the founding of the order. The first, religious, is the opposition of the Roman Catholic Church, although Freemasonry does not bar Catholics and a great many belong to lodges in Latin America and the Philippines. The second is political. For about a decade following the abduction from Batavia, N.Y., in 1827, of William Morgan (1774?-1826), a

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Freemason who had threatened to publish Masonic secrets and who was commonly thought to have been kidnapped by the Masons, there was such a general outcry that many Masonic lodges had to be abandoned throughout the Eastern and Middle States. In the Northern States the Antimasonic Party was formed; for a few years it was practically the only opponent to the Democratic Party. In 1832 the Antimasonic Party nominated a lawyer, William Wirt (1772–1834), as its candidate for the Presidency, but he was defeated by Andrew Jackson (q.v.), who, ironically, was a Mason. After that date the Freemasons encountered little political opposition in the U.S. or elsewhere, until the rise to power of the National Socialists in Germany in 1933. In that year the German dictator Adolf Hitler (q.v.) charged the Masons with responsibility for various subversive activities, including all the incidents leading to World War I, and decreed the dissolution of all Masonic bodies in Germany.

FREE METHODIST CHURCH OF NORTH AMERICA, Protestant denomination organized in Pekin, N.Y., in 1860. The denomination adheres strictly to the doctrines and practices of primitive Methodism (q.v.), and its polity is substantially the same as that of The Methodist Church (q.v.). The chief policymaking body is a quinquennial general conference. Headquarters is at Winona Lake, Ind. The biweekly *Light and Life* is a widely known denominational periodical. The Free Methodist Church is one of a group of independent denominations known as Holiness bodies because the members attach central importance to the doctrine of Christian perfection, known also as perfect love or holiness. See **HOLINESS CHURCHES**.

The denomination originated among ministers and laymen who were expelled from the Methodist Episcopal Church in the Genesee (New York) Conference, joined by others who chose to withdraw, because of their dissatisfaction with the contemporary trend away from observation of the doctrines and prudentials interpreted by the founder of Methodism, John Wesley (see *under* **WESLEY**).

In 1972 the church reported about 70,750 members in more than 1100 churches in North America and 62,000 members in overseas churches. The denomination supports several institutions of higher education, a theological seminary, a worldwide radio ministry, and an international missionary program.

FREE PORT, harbor in which the vessels of all nations may enter, and load or unload without the payment of import duty. Charges are made

for harbor services only. Goods unloaded may be reshipped elsewhere on payment of a transit duty, or may be admitted to the particular country for consumption upon the payment of import duty. More common than the free port, as a facility for the international transit of goods, is the free zone maintained in many ports. New York City, for instance, has a free zone located on Staten Island in New York Bay.

FREEPORT, city in Illinois, and county seat of Stephenson Co., on the Pecatonica R., about 105 miles N.W. of Chicago. The city is the commercial center and distribution point of a farming and dairying region. Industries include insurance, railroad shops, and factories for the manufacture of toys, hardware, electrical equipment, tires, keyboards, brooms, proprietary drugs, insecticides, toiletries, spices, plastic and paper products, and fabricated metals. A granite boulder marks the site of a political debate between the American political leaders Abraham Lincoln and Stephen Arnold Douglas (qq.v.) on Aug. 27, 1858. In this debate Douglas advanced the so-called Freeport heresy, which was to the effect that, despite the decision of the United States Supreme Court in the Dred Scott case (q.v.), any free territory might virtually exclude the slave system by passing laws incompatible with slavery. Freeport was settled in 1835, became the county seat in 1837, and was incorporated as a city in 1855. Pop. (1960) 26,628; (1970) 27,736.

FREEPORT, city of Texas, in Brazoria Co., on the Gulf of Mexico, at the mouth of the Brazos R., on the Gulf Intracoastal Waterway, about 44 miles S.W. of Galveston. Freeport has a deep-water port. An industrial center, the city manufactures chemicals, extracts magnesium from the sea, and has a seawater-purification plant. Pop. (1960) 11,619; (1970) 11,997.

FREEPORT, village of New York, in Nassau Co., on the S. shore of Long Island, 23 miles E. of New York City, of which it is a residential suburb. The principal industries in the village are sport and commercial fishing, and the manufacture of plastics, fabricated iron, bedding, boats, and propellers. The area was settled about 1650 and was incorporated as a village in 1892. Pop. (1960) 34,419; (1970) 40,374.

FREER GALLERY. See **SMITHSONIAN INSTITUTION**.

FREESIA, genus of plants belonging to the Iris family, Iridaceae, named in honor of the German physician F. H. T. Freese (1795?–1876). Freesias are native to the Cape of Good Hope, South Africa. The fragrant tubular flowers of freesia vary in color from white to yellow, orange, lavender, and pink. Freesias grow from a corm, or thickened underground stem. They are



Freesia, *Freesia refracta*

important as commercial cut flowers and are grown for market in southern California. They are not successful garden plants in the northern United States but may be grown in greenhouses. Freesias raised in the U.S. are varieties of two wild species, *F. armstrongi* and *F. refracta*, or of their hybrids. See IRIS.

FREE SILVER. See MONEY: *The Monetary System of the United States*.

FREE-SOIL PARTY, American political party organized in 1848 on a platform opposing the extension of slavery (q.v.). The growing conflict between proslavery and antislavery forces in the United States was intensified by the acquisition of new territories from Mexico and the ensuing argument over whether or not slavery would be permitted in those territories; see MEXICAN WAR. The defeat of the Wilmot Proviso (q.v.), intended to prevent the extension of slavery, and the struggle over it in Congress brought the conflict to a head; the refusal of both the Whig and Democratic parties to endorse the principles of the proviso convinced various opposition groups of the need for a new party. The major groups involved in the organization of the Free-Soil Party at a convention in Buffalo, N.Y., in 1848 were the abolitionist Liberty Party (q.v.), the antislavery Whigs, and a radical fac-

tion of the New York Democrats, the Barnburners, who had broken with the State party when it came under control of the conservative Hunkers. See POLITICAL PARTIES IN THE UNITED STATES.

The Free-Soil convention nominated Martin Van Buren (q.v.) and Charles Francis Adams (see under ADAMS) as candidates for President and Vice-President, respectively, and adopted a platform opposed to the extension of slavery and calling also for a homestead law and a tariff for revenue only. The slogan of the party was "free soil, free speech, free labor, and free men". The party polled 291,263 votes in the election of 1848; it carried no States, but turned the election in New York to the Whigs, and thus played a decisive role in the election of President Zachary Taylor (q.v.). The party also elected two U.S. Senators and fourteen Representatives. The Compromise Measures of 1850 (q.v.) caused the return of the Barnburners to the Democratic Party and the loss of other allies, but the Free-Soil Party continued to function and, though it polled fewer votes than four years previously, in 1852 it increased its representation in Congress. The passage of the Kansas-Nebraska Act (q.v.) in 1854 caused the final breaking of the old party lines and resulted in the formation of the Republican Party (q.v.), into which the Free-Soil Party was absorbed.

FREETHINKER, one whose opinions are independently formed, and especially one whose religious opinions are not based on orthodox theory. In the latter sense the term is often applied to the English Deists of the 18th century; see DEISM. The term became popular after the publication of *A Discourse of Freethinking, Occasioned by the Rise and Growth of a Sect Called Freethinkers* (1713), written by the English Deist Anthony Collins (1676–1729). The term freethinker is also frequently used to designate skeptics and unbelievers.

FREETOWN, city, capital, and seaport of Sierra Leone, on the s. bank of the estuary of the Sierra Leone R. The city lies on sloping ground at the end of a range of hills and faces a sheltered harbor that is one of the best on the w. coast of Africa. It is a major port of call with facilities for deepwater ships and is the center for railway, air, road, and other communications links in Sierra Leone.

Freetown was founded by British philanthropists in 1787 as a home for liberated slaves. It is the site of Fourah Bay College, established in 1827. Pop. (1972 est.) 195,800.

FREE TRADE AND PROTECTION, terms used in commerce to designate contrasting policies of foreign trade (q.v.). In current usage in eco-

FREE TRADE AND PROTECTION

nomics and political science, free trade signifies the interchange of commodities across political frontiers without legal impediments such as tariffs, quotas, or exchange controls. Protection signifies the fostering of domestic industrial or agricultural production by means of import tariffs or other legal obstacles to the movement of goods across frontiers. See **TARIFF**; **TARIFFS, UNITED STATES**.

Early Free-Trade Doctrines. Foreign-trade doctrines began to develop with the emergence of dynastic nation-states during the 15th century. One early form of economic policy, known as mercantilism, dominated western Europe from about 1500 to about 1800; see **MERCANTILE SYSTEM, THE**. Supporters of this policy worked to promote national unity and increase the strength of the state. They considered wealth (q.v.) a necessary condition of power, and the accumulation of gold and silver specie a necessary condition of wealth. Countries without gold or silver mines acquired specie by maintaining a surplus of exports over imports through strict governmental control of foreign trade.

A reaction against strict governmental control of trade occurred in France during the 18th century. This led to the formulation of the first theory of free trade by a group of economic philosophers known as the physiocrats, who were followers of the economist François Quesnay (q.v.). The physiocrats maintained that the free movement of goods was in accordance with the principles of natural liberty. Although their ideas had little effect in France, they did influence the British economist Adam Smith (q.v.), whose free-trade theories contributed to the later development of governmental policy in Great Britain.

Smith decisively refuted the protectionist conclusions of mercantilist thought. He pointed out that wealth consisted not in specie itself but in the material that specie could purchase. Governmental regulation of trade therefore actually reduced the wealth of nations, because it prevented them from purchasing the maximum amount of commodities at the lowest possible price. With free trade, however, each nation could increase its wealth by specializing in the export of the goods that it produced most cheaply and by importing goods that were produced less expensively elsewhere.

According to Smith, each country would specialize in the production and export of goods in which it had an absolute advantage. Another British economist, David Ricardo (q.v.), extended the analysis early in the 19th century to

encompass the more general case of comparative advantage. Ricardo noted that some nations might lack an absolute advantage in the production of any commodity. Even these nations could gain from free trade, however, if they concentrated on those commodities in which they had a relative advantage in production. This principle has remained the theoretical basis of all argument for free trade.

Ricardo assumed that all nations would share in the gains from free trade. The British philosopher and economist John Stuart Mill (q.v.) later demonstrated that such gains depend on the strength of reciprocal demand for imports and exports. The stronger the demand for the exports of a country relative to its demand for imports, the greater its gain from free trade. The gain would be reflected in an improvement in the international terms of trade for the country, as expressed by the ratio of its export prices to its import prices.

Modern Trade Theory. The classical theory of trade developed by Smith, Ricardo, and Mill was concerned primarily with the analysis of the gains from trade. Modern trade theory, by contrast, takes the principle of comparative advantage for granted. It is primarily concerned with the analysis of the basis for trade and with accounting for differences in comparative advantage.

Classical theorists assumed that differences in comparative advantage resulted from differences in the productivity of resources, reflecting the unequal distribution of technologies and labor skills among nations. A more complete explanation was offered by several 20th-century economists, who noted that differences in the prices of final goods tend to reflect differences in the prices of productive resources and that the latter are accounted for mainly by differences in availability of resources. Countries specialize in the production and export of goods requiring relatively large amounts of those resources that they possess in abundance, and import goods requiring relatively large amounts of resources that are scarce within their borders but abundant elsewhere.

Arguments for Protection. Despite the conclusions of classical theory, few countries have ever actually adopted a policy of free trade. The major exception was Great Britain, which, from the 1840's until the 1930's, levied no import duties of any kind. The historical prevalence of protectionist policies reflects in part the strength of industrial vested interests fearful of foreign competition, and in part the strength of various theoretical arguments for protection.

Such arguments can be classified in three groups: those intended to influence the composition of production; those intended to influence the level of employment; and those intended to influence the distribution of income. Under appropriate circumstances all three groups of arguments have theoretical validity, although each has its limitations as well.

One of the oldest arguments for protection is the so-called infant-industry argument. The basic statement of the argument in the United States was first made by the American statesman Alexander Hamilton (q.v.) in his *Report on Manufactures* (1791), which advocated protection as a means of promoting industrial development. According to this theory, when foreign competition is reduced or eliminated by import barriers, domestic industries can develop rapidly. After their development is complete, they should theoretically be able to hold their own in competition with industries of other nations, and protection should no longer be required. In practice, however, protection frequently cannot be removed, because the domestic industries never develop sufficient competitive strength. The limitation of the infant-industry argument is its inability to identify those industries that are capable of growing to genuine maturity.

The national-defense argument for protection seeks to avoid dependence on foreign sources for supplies of essential materials or finished products that might be denied in time of war. The limitation of this argument is that it is difficult to identify those industries indispensable for national defense.

A third instance in which protection is advocated is to counter dumping from abroad. Dumping occurs when products are made available as imports at prices lower than the prices prevailing for the same products in the exporting country. Protection may be justified in these circumstances, but only if it is clear that the intention of foreign suppliers is to establish a permanent monopolistic position by driving domestic suppliers out of business.

During periods of unemployment, protection is often urged as a means of increasing employment. With imports reduced, demand for domestic substitutes will be stimulated, expanding production at home. Economists call this a "beggar-my-neighbor" policy: the improvement of employment at home is achieved entirely at the expense of employment elsewhere. The limitation of such a practice is that it invites retaliation from other nations suffering from similar problems of unemployment.

Protection can be used to redistribute income

either within nations or between nations. For example, if a nation finds that the demand for its exports is relatively strong, it can gain income at the expense of other countries by imposing tariffs or other import barriers. Foreigners will then find it more difficult than previously to earn the income they need to pay for the exports they desire. Consequently, they will be forced to reduce their prices, thus improving the terms of trade for the protectionist nation. Like the employment argument, this method invites retaliation from abroad.

Recent Developments. While most countries officially favor freer trade and deny protectionism, the achievement of this goal is somewhat difficult, even among highly industrialized countries. Since World War II a concerted move has been under way by the leading trading nations to promote freer trade and remove protection barriers. When economies are booming, free trade is supported. But when recessions occur on a worldwide scale, as they did in the mid-1970's, then many nations become more protectionist because of national interest and pressure from organized labor and other interest groups severely affected by prolonged recessions.

See also COMMERCIAL TREATIES; ECONOMICS; EUROPEAN ECONOMIC COMMUNITY; EUROPEAN FREE TRADE ASSOCIATION; GENERAL AGREEMENT ON TARIFFS AND TRADE; INTER-AMERICAN COOPERATION; MONOPOLY AND COMPETITION. B.J.C.

FREE VERSE, rhymed or unrhymed poetry composed without attention to rules of versification (q.v.). Free verse was invented and labeled *vers libre* (Fr., "free verse") by a group of French poets of the late 19th century, including Gustave Kahn (1859–1936) and other symbolists (q.v.). Their purpose was to deliver French poetry from the restrictions of formal metrical patterns and to recreate instead the free rhythms of natural speech. Pointing to the American poet Walt Whitman (q.v.) as their precursor, they wrote lines of varying length and cadence, usually not rhymed. The emotional content or meaning of the work was expressed through its rhythm. Free verse has also been produced by such American poets as Amy Lowell, Ezra Pound, and Carl Sandburg (qq.v.).

FREE WILL, power or ability of the human mind to choose a course of action or make a decision without being subject to restraints imposed by antecedent causes, by necessity, or by divine predetermination. A completely free-willed act is itself a cause and not an effect; it is beyond causal sequence or the law of causality (q.v.). The question of man's ability to deter-

FREE WILL

mine his actions is important in philosophy, particularly in metaphysics and ethics (qq.v.), and in theology (q.v.). Generally, the extreme doctrine affirming freedom of the will (q.v.) is termed libertarianism; its opposite, determinism (q.v.), maintains that human action is not willed freely, but is rather the result of such influences as passions, desires, physical conditions, and external circumstances beyond the control of the individual.

Freedom of the will has necessarily been a concern of metaphysicians, who attempt to formulate theories explaining the nature of ultimate, universal reality and man's relationship to his universe. Some metaphysicians hold that if the universe is rational, it must be based on a sequence of cause and effect: every action, or effect, must be preceded by a cause and must form a part of the unbroken chain of causation extending back to the First Cause, that is, God (q.v.), or the Divine. An act of absolute free will on the part of man or animal is, however, an uncaused act outside the causal chain; to accept the possibility of an uncaused act negates such divine, rational order and makes the universe seem irrational. Viewed in this manner, this question has never been satisfactorily resolved. During the Middle Ages (q.v.), the inexplicability of free will led to intense argument among religious philosophers and to the famous dilemma known as Buridan's Ass (see BURIDAN).

The validity of free will has also been a subject of considerable debate among ethical philosophers. It would appear that a system of ethics must imply free will, for the denial of the ability to choose a course of action would seem to negate the possibility of moral judgment. A man without moral judgment is not responsible for his actions. In an attempt to resolve this problem, ethical philosophers have taken a great variety of positions, ranging from absolute determinism to absolute libertarianism. The Greek philosophers Socrates and Plato (qq.v.) maintained that men could will their own actions, but that those actions alone were truly free which accorded with the good or harmony of the whole. Thus, only a wise action is free. Baruch Spinoza (q.v.), the Dutch philosopher, reinterpreted free will as self-determination, that is, insofar as man fits into God's nature and the world's own nature. Immanuel Kant (q.v.), the German philosopher, believed that man must be free because freedom is a necessary postulate of the moral consciousness; the Kantian categorical imperative (q.v.) is beyond any theoretical analysis. The prevailing philosophical opinion has been that partial self-determina-

tion exists, and that although many considerations other than will are involved in the formation of moral judgments, in certain circumstances there remains a core, however small, of creative decision.

A Concern of Theologians. Free will is important in theology. One of the basic tenets of traditional Christian theology is that God is omniscient and omnipotent, and that every human action is foreordained by Him. The doctrine of predestination (q.v.), the theological counterpart of determinism, seemingly precludes the existence of free will. Because morality, duty, and the avoidance of sin (q.v.) are also basic elements in Christian teaching, how, it is asked, can man be morally responsible once predestination is accepted? Many attempts have been made by theologians to explain this paradox. Saint Augustine (q.v.), the great father and doctor of the Church, firmly believed in predestination, holding that only those elected by God would attain salvation; no one, however, knows who is among the elect, and therefore all should lead God-fearing, religious lives. Freedom, for him, was the gift of divine grace (q.v.). This doctrine was opposed by the British monk Pelagius (360?–420?) and particularly by his followers, who maintained that Adam's sin concerned only Adam and not the whole human race, and that every man, although helped by divine grace to attain his own salvation, has complete freedom of will to choose or reject the way to God; see PELAGIANISM. Eventually, Roman Catholic theologians stated the doctrine of prevenient grace to explain free will; according to this doctrine, God bestows on man the grace to will himself into a state of grace. During the Reformation (q.v.), the question of free will became a religious battleground. Many Protestant sects, notably the Calvinists (see CALVINISM) emphasized the Augustinian doctrine of predestination and the complete exclusion of free will. Calvinistic predestination was considered a paramount heresy by the Roman Catholic Church; and the Council of Trent (see TRENT, COUNCIL OF) in the 16th century condemned all who denied free will. Still the problem was not resolved. The French Roman Catholic prelate Jacques Bénigne Bossuet (q.v.) offered yet another approach, which became widely held; he stated that free will and divine foreknowledge were certain truths that must be accepted even though there is no logical connection between them.

Current Attitudes. Psychologists have found it difficult to explain free will; their method of scientific causality predicates determinism. The rational philosophers of the 17th and 18th centu-

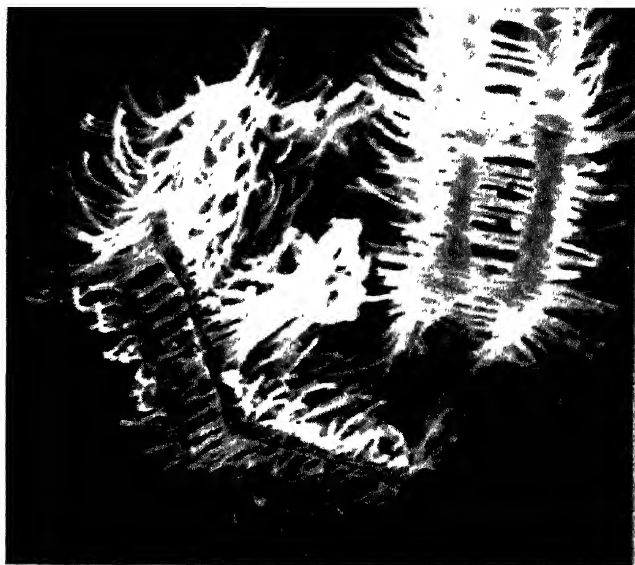
ries, who were, in a sense, psychologists, attempted to state mechanistic laws that would include mental phenomena as they did physical phenomena, such as gravity; free will, being anarchistic by definition, could not be patterned into law. Certain recent psychologists, including the Americans Rollo May (1909–), Gordon Willard Allport (1897–), and Abraham Harold Maslow (1908–), and especially the advocates of existentialism (q.v.), have, however, recognized a factor of spontaneity in the human mind that is admitted to lie outside any possible scientific law. This spontaneity can be interpreted to be free will, or at least a measure of self-determination that men feel themselves to possess and by which they make moral judgments.

See ARMINIANISM; FATALISM.

FREEZING POINT, temperature at which a liquid congeals into the solid state at a given pressure; see PRESSURE; TEMPERATURE.

The freezing point of a pure (unmixed) liquid is essentially the same as the melting point of the same substance in its solid form and may be regarded as the temperature at which the solid and liquid states of the substance are in equilibrium. If heat is applied to a mixture of liquid and solid substance at its freezing point, the temperature of the substance remains constant until it has become completely liquefied, because the heat is absorbed not in warming the substance but in providing the latent heat of fusion. Similarly, if heat is abstracted from a mixture of liquid and solid substance at its freezing point, the substance will remain at the same temperature until it has become completely solid, because heat is given off by the substance in its change from the liquid to the solid state. Hence the freezing point or melting point of a pure substance may be defined also as the temperature at which freezing or melting continues once it has commenced.

All solids melt when heated to their melting points, but most liquids can remain liquid even though cooled below their freezing points. A liquid may remain in this supercooled state for some time. This phenomenon is explained by molecular theory, which conceived the molecules of a solid as being well ordered and the molecules of a liquid as being disordered. In order to solidify, a liquid must have a nucleus (a point of molecular orderliness) around which the disordered molecules can crystallize. The formation of a nucleus is a matter of chance, but once a nucleus forms, the supercooled liquid will solidify rapidly. The freezing point of a solution is lower than the freezing point of the



Magnified details of the growth of airborne ice crystals below the freezing point in air that contains a trace of ammonia. The application of a plastic coating allows the crystals to last long enough to be photographed.

Naval Weapons Center, California

pure solvent before introduction of the solute (substance dissolved).

The amount that the freezing point is lowered depends on the molecular concentration of the solute and on whether the solution is an electrolyte. Nonelectrolytic solutions have higher freezing points for a given concentration of solute than do electrolytes. The molecular weight of an unknown or unidentified substance may be determined by measuring the amount by which the freezing point of a solvent is lowered when a known amount of the unidentified substance is dissolved in it. This process of determining molecular weights is called cryoscopy.

In mixed substances and alloys, the freezing point of the mixture may be much lower than the freezing points of any of its components.

The freezing point of most substances is increased by increase of pressure. In substances, however, that expand on freezing, as, for example, water, pressure lowers the freezing point. An example of this effect can be observed if a heavy object is placed on a block of ice (q.v.). The area immediately underneath the object will begin to turn to liquid and will re-freeze when the object is removed without any change in temperature. This process is known as regelation.

See CRYOGENICS; CRYSTAL.

FREIBERG, city of East Germany, in Karl-Marx-Stadt District, on the Freiburger Mulde R., about 20 miles s.w. of Dresden. It lies on the n. slopes of the Erzgebirge at 1325 ft. above sea level. Freiberg has long been the center of the important lead- and silver-mining industry in the former state of Saxony (q.v.). Manufactures include

FREIBURG

gold and silver articles, woolen cloth, leather, china, machinery, chemicals, scientific and optical instruments, and cigars. The city also contains a mining college and a radium research facility.

The area was settled about 1180, after the discovery of silver deposits nearby. Freiburg contains a cathedral originally dating from the 12th century, rebuilt in Gothic style after destruction by fire in the late 15th century, and restored in 1893. A doorway, known as the Golden Gate, remains from the original structure. Henry the Pious, Duke of Saxony (1473–1541), and a number of his successors are buried in the cathedral. Pop. (1972) 50,621.

FREIBURG (Ger. *Freiburg im Breisgau*), city of West Germany, in Baden-Württemberg State, at the foot of Schlossberg Mt., in the Breisgau Valley of the Dreisam R., about 80 miles S.E. of Stuttgart, and about 40 miles N. of Basel, Switzerland. Industrial establishments in the city produce machinery, scientific and musical instruments, chemicals, paper, furniture, synthetic fiber, textiles, tobacco products, sugar, chocolate, beer, and wine.

The city is the site of the famous Albert Ludwig University, founded in 1457. The Freiburg Minster, or cathedral, built between the 13th and 16th centuries, is one of the finest Gothic ecclesiastical structures in Germany. It is surmounted by a tower 386 ft. tall and contains paintings by the German artists Hans Holbein the Younger (q.v.) and Hans Baldung (1476?–1545).

Freiburg dates from the late 11th century. It was a free town in 1120, when it began to attain considerable commercial prosperity. In 1219 it came under the control of the counts of Urach. In 1366 it purchased its freedom for 20,000 silver marks. Unable, however, to repay the creditors, Freiburg passed under the control of the Hapsburg (q.v.) family. In 1644, during the Thirty Years' War (q.v.), Freiburg and the surrounding area were the site of several major military engagements between the French and Austrian-Bavarian forces. For a short period in the late 17th century, the city belonged to the French, and in 1806 it was made a part of Baden, now Baden-Württemberg State. Since 1821 it has been an archbishopric, including the sees of Limburg, Mainz, and Rottenburg. Most of the old section of Freiburg was destroyed during World War II. French troops occupied the city in April, 1945; it was thus part of the French zone of occupation. Pop. (1970) 163,600.

FREIGHT SERVICE. See RAILROADS: *Freight Cars and Service.*

FREI MONTALVA, Eduardo (1910?–), Chilean statesman, born in Santiago. He was educated at the Catholic University of Chile, from which he earned an LL.D. degree in 1933. Frei was a member of the Chilean Conservative Party but became dissatisfied with its unyielding defense of the status quo. Consequently, in 1938, he participated in the establishment of the liberal National Falange, which was based on Christian Socialist principles. From 1945 to 1949 he was minister of roads and public works. Beginning in 1949 he was a member of the Chilean senate. In 1957 the National Falange joined with the Social Christian Conservative Party to form the Christian Democratic Party, and Frei became the leader of the new party. In the national elections of 1964 he campaigned as a "middle-of-the-road" Christian Democrat and won a six-year term as president of Chile.

Following his election Frei embarked on a program of sweeping economic and social reform, which included tax reform, land redistribution, a higher minimum wage, and voting reforms. These reforms also included the partial nationalization of the copper industry, by which the government bought into partnership with the three large United States companies controlling that vital industry. Prevented by the Chilean constitution from succeeding himself, Frei was succeeded in 1970 by the Chilean senator Salvador Allende Gossens (1908–73), a member of the Chilean Socialist Party. See CHILE: *History.*

FREMANTLE, city of Australia, in Western Australia State, on the Indian Ocean, at the mouth of the Swan R., immediately S. of Perth. It is a part of the Perth metropolitan area. Fremantle is the chief seaport of Western Australia, and its extensive harbor facilities make it an important port of call for vessels plying the European and South African trade routes. The principal industrial establishments are shipyards, iron foundries, furniture factories, flour mills, sawmills, soap factories, tanneries, and breweries. The leading items of export are timber, wheat, wool, and fruit. The town, founded in 1825, is one of the oldest settlements in Australia. Pop. (1971 prelim.) 25,990.

FRÉMIET, Emmanuel (1824–1910), French sculptor, born in Paris. He studied with his uncle, the noted French sculptor François Rude, and subsequently produced many monumental equestrian statues and statues of animals. In 1875 he became professor of drawing and modeling at the Jardin des Plantes, Paris. He was elected to the Académie des Beaux Arts in 1892 and became a member of the Royal Soci-

ety, London, in 1904. His statues of animals include the "Wounded Hound" (1910) in the Luxembourg Museum, Paris, and "Gorilla Carrying Off a Woman" (1887) in Nantes, France. Among his equestrian statues are "Joan of Arc" (1899) in the Place des Pyramides, Paris; "Du Guesclin" (1902) in Dinan, France; "Colonel Howard" (1903) in Mount Vernon Square, Baltimore, Md.; and "Bolivar" (1910) in Bogotá, Colombia. He also sculpted the colossal statue "Ferdinand de Lesseps" (1899) in Suez, United Arab Republic.

FREMONT, city of California, in Alameda Co., at the S.E. end of San Francisco Bay, 15 miles N. of San Jose, and 25 miles S. of Oakland. Lying between Alameda and Coyote creeks, Fremont surrounds the smaller city of Newark. Industries of Fremont include production of chemicals, automobile assemblies, furniture, and canned fruits. Dairy farms, vineyards, and fruit orchards are nearby. Fremont is the site of the Spanish Mission of San José de Guadalupe (1797) and Ohlone College. Incorporated in 1956, the city was formed by combining Mission San Jose, Irvington, Niles, Centerville, and Warm Springs. Pop. (1960) 43,790; (1970) 100,869.

FREMONT, city in Nebraska, and county seat of Dodge Co., on the Platte R., 37 miles N.W. of Omaha. Fremont is served by railroad and has a municipal airport. The city, surrounded by a fertile agricultural region, is an important market for grain, hybrid corn and seed, and livestock. The principal industrial establishments in the city include grain elevators, flour and feed mills, creameries, nurseries, canneries, poultry-processing plants, and plants producing refrigeration equipment, machine parts, tile, cement products, and beverages. Fremont is the site of Western Theological Seminary (Lutheran), founded in 1893, and Midland College (Lutheran), established at Atchison, Kans., in 1887 and moved to Fremont in 1910. The city was founded in 1856 and named in honor of the American explorer John Charles Frémont (q.v.). It was incorporated in 1859 and became a city in 1871. Pop. (1960) 19,698; (1970) 22,962.

FREMONT, city in Ohio, and county seat of Sandusky Co., about 20 miles S.W. of Sandusky. Fremont is an industrial and commercial center located in an agricultural area. It manufactures electrical products, surgical instruments, cutlery, rubber goods, and automobile parts. At nearby Spiegel Grove State Park is the home of President Rutherford B. Hayes (q.v.). Pop. (1960) 18,767; (1970) 18,490.

FRÉMONT, John Charles (1813–90), American explorer, army officer, and politician, born in Savannah, Ga., and educated at the College of

Charleston, S.C. In 1838, after having been a mathematics instructor and an assistant engineer for a rail survey, he was commissioned second lieutenant in the corps of engineers, United States Army. During the following year Frémont was a member of the expedition of the French explorer Joseph Nicolas Nicollet (1786–1843), which surveyed and mapped the region between the upper Mississippi and Missouri rivers. Between 1842 and 1845 Frémont led three expeditions into the Oregon territory. During the



John Charles Frémont

first, in 1842, he mapped most of the Oregon Trail (q.v.) and ascended, in present-day Wyoming, the second-highest peak in the Wind River Mts., afterward called Fremont Peak (13,730 ft.). In 1843 he completed the survey of the Oregon Trail to the mouth of the Columbia R. on the Pacific coast. The party, guided by the famous American scout Christopher "Kit" Carson (q.v.), traveled to the Oregon settlements, turned south and then east to northwestern Nevada, and continued to the Truckee and Carson rivers. Frémont and the entire expedition then made a midwinter crossing of the Sierra Nevada (q.v.) Mts. and wintered near Sutter's Fort on the Sacramento R. in California. The next spring the expedition made the return trip by way of the southern end of the Sierra Nevada, across the Great Salt Lake (q.v.). Frémont made his third expedition in 1845 for the purpose of further exploration of the area known as the Great Basin (q.v.) and of the Pacific coast.

During the Mexican War (1846–48) Frémont attained the rank of major and assisted greatly in the conquest of California. He was appointed

FRENCH

civil governor of California by the American naval officer Commodore Robert Field Stockton (1795–1866), but in a conflict of authority between Stockton and the American army officer Brigadier General Stephen Watts Kearny (q.v.), Frémont, refusing to obey Kearny's orders, was arrested for mutiny and insubordination and was subsequently court-martialed. He resigned his commission after the American President James Knox Polk (q.v.) remitted his sentence of dismissal from the service. In the winter of 1848 and 1849 Frémont led an expedition to locate passes for a proposed railway line from the upper Rio Grande R. to California. During the California gold rush, gold was discovered on Frémont's California estate, and he became extremely wealthy. In 1850 he was elected one of the first two senators from California, serving until 1851. He was the 1856 Presidential candidate of the newly formed Republican Party, but was defeated by the American political leader James Buchanan (q.v.). During the American Civil War Frémont was appointed a major general in the Union Army and held several important but brief commands; he resigned his commission in 1862 rather than serve under the American General John Pope (1822–92). Again in 1864 Frémont was a Presidential nominee, this time by the radical Republican faction; he withdrew, however, in favor of President Abraham Lincoln (q.v.). In 1870 Frémont lost his fortune in a venture to construct a transcontinental railroad. He served as governor of the Territory of Arizona from 1878 to 1883. In 1890 he was restored to the rank of major general and retired with full pay. Frémont wrote a *Report of the Exploring Expedition to the Rocky Mountains in the Year 1842, and to Oregon and North California in the Years 1843–44* (1845) and *Memories of My Life* (1887).

His wife, Jessie Benton Frémont (1824–1902) was the daughter of the American statesman Thomas Hart Benton (see under BENTON). She assisted Frémont with his writings, and was also the author of several books, including the *Story of the Guard, a Chronicle of the War* (1863), *A Year of American Travel* (1878), and *Far West Sketches* (1890).

FRENCH, Daniel Chester (1850–1931), American sculptor, born at Exeter, N.H., and educated at the Massachusetts Institute of Technology. He studied in Boston, Florence, and Paris. French was one of the best-known American sculptors of his time. His work is characterized by graceful figures, poetic feeling, restraint and dignity in the expression of emotion, and masterful technique. His first important work, the

"Minute Man" a statue in Concord, Mass., was unveiled on April 19, 1875, the centennial of the first battle of the American Revolution (q.v.). French is perhaps best known for his monumental seated "Lincoln" (1920) in the Lincoln Memorial (q.v.) in Washington, D.C. Among his other works are the groups "Africa", "America", "Asia", and "Europe" (all in front of the Custom House, New York City); the bronze doors of the Boston Public Library; the seated statue "John Harvard" (1880, Harvard University); the equestrian statues "General Grant" (1899, Philadelphia, Pa.) and "General Washington" (1900, Paris, France); and many portrait busts.

FRENCH, John Denton Pinkstone, 1st Earl of Ypres (1852–1925), British military leader, born in Ripple, Kent, England. He entered the Royal Navy in 1866, serving as a cadet and midshipman. In 1870 he joined the militia and in 1874 entered the regular army. He distinguished himself with the 19th Regiment of Hussars in the Nile expedition (1884–85) and was commander of his regiment from 1889 to 1893. During the South African War (q.v.) French served as commander of a cavalry division, distinguishing himself by relieving Kimberley and occupying Bloemfontein, now towns in the Republic of South Africa. In 1907 he was promoted to general and was inspector general of home forces until 1912, when he was made chief of the imperial general staff. The following year he became field marshal. After the outbreak of World War I he was made supreme commander of the British armies on the western front; at the first Battle of Ypres (see YPRES, BATTLE OF) he prevented the Germans from breaking through to Calais. In December, 1915, he resigned under criticism over the cost in men and matériel incurred by the advance of the armies in France. After his return to England, French was made a viscount and was commander in chief in the United Kingdom until 1918, when he was appointed lord lieutenant of Ireland. Upon his resignation in 1921 he was made an earl. He wrote a volume of personal reminiscence, *1914*, which was published at the end of World War I.

FRENCH ACADEMY, one of a group of five academies constituting the Institute of France (q.v.).

FRENCH AND INDIAN WAR, name applied to the last of the series of wars between Great Britain and France for control of North America. The war was the American phase of the Seven Years' War (q.v.), a worldwide struggle for colonial supremacy waged between 1756 and 1763. The American action actually broke out in 1754.

The traditional areas of Anglo-French friction

had been the Canada-New England-New York frontier and the Caribbean islands. By the middle of the 18th century, however, the French were moving into the Ohio Valley in an attempt to link Canada with their Louisiana and Mississippi Valley possessions. French moves ultimately would have contained the English east of the Allegheny Mts. In 1753 Robert Dinwiddie (1693–1770), governor of Virginia, sent a small expedition under George Washington (q.v.), then a young American surveyor, to warn the French to stop trespassing on the British claims in the Ohio Valley. Washington returned with a French rejection of the British claims, and in 1754 both sides moved. The French, seizing a half-built British fort at the forks of the Ohio R., built Fort Duquesne on the site. Meanwhile an expedition was dispatched from Virginia to seize the same ground. When Washington with a small militia force challenged the French, he was defeated and forced to surrender his hastily constructed stockade, Fort Necessity, in the Great Meadows in western Pennsylvania. The surrender came on July 3, 1754; the Anglo-French skirmish, however, signaled the opening of the French and Indian War.

The first years of the war were disastrous for Great Britain. In July, 1755, the British commander-in-chief Edward Braddock (q.v.), marching on Fort Duquesne, was defeated;

Braddock himself was mortally wounded. The frontiers of Pennsylvania, Maryland, and Virginia were attacked by the French and their Algonquian Indian allies, and in 1757 the French captured British posts along the Canada-New York border. The only notable British success was in the Acadian peninsula, now Nova Scotia, where the British captured Fort Beauséjour in 1755 and expelled the French-speaking Acadians; see ACADIA.

In 1757, however, the tide began to turn. The British statesman William Pitt, called the Elder (see under PITT), was put in charge of the war effort and began to prosecute it vigorously throughout the world. To North America he dispatched a number of young British generals, among them Jeffrey Amherst and James Wolfe (qq.v.), to replace ineffective leaders. Through 1758 and into 1759 the list of British successes lengthened; the forts Duquesne, Frontenac, Niagara, and Louisbourg were taken, and Crown Point and Ticonderoga were recovered. These victories were climaxed on Sept. 13, 1759, when Wolfe defeated the French, under the French soldier Marquis Louis Joseph de Montcalm de Saint-Veran, on the Plains of Abraham (qq.v.).

Indian allies of the French participating in the defeat of General Edward Braddock at Fort Duquesne in July, 1755 (from Ballou's Pictorial Drawing-Room Companion, 1855).

Library of Congress



FRENCH ART AND ARCHITECTURE

above Québec. The next year the British captured Montréal, and after they repulsed an attempted French invasion in 1761, all Canada was theirs. Meanwhile, in the Caribbean the British had taken most of the French sugar islands. The war in the Caribbean continued through 1762, with Spain joining as an ally of France.

The war was formally ended by the Treaty of Paris, signed Feb. 10, 1763, by France, Spain, and Great Britain. The agreement gave the British control of Canada, Acadia, the eastern half of the Mississippi Valley, and Florida; the latter was obtained from Spain in exchange for Cuba, which the British had taken in 1762. France was eliminated as a colonial power in America, although she retained two small islands in the Gulf of Saint Lawrence, was granted fishing rights off Newfoundland, and regained the important Caribbean islands of Martinique and Guadeloupe. For the latter two islands, France ceded Grenada and the Grenadines in the West Indies to the British. Before the Paris negotiations, France ceded New Orleans and the western portion of her Mississippi Valley territory to Spain.

The French and Indian War helped to set the stage for the American Revolution (q.v.). With the French eliminated, the American colonists were less dependent on British military protection. Further, the colonial militia had demonstrated that it could match British regulars in fighting ability, at least on their home ground. Experiences in the war also disclosed significant weaknesses in the imperial system, at the same time pointing up to the colonists the need for intercolonial cooperation in handling the Indian problem. J.F.B.

FRENCH ART AND ARCHITECTURE, art and architecture of France, from the 6th century to the present day. Beginning early in the 6th century the lands that were to become modern France were unified under the Merovingian and Carolingian (qq.v.) kings. Before this time, Roman civilization had advanced and receded from those lands, leaving traces that continued to influence the culture of the indigenous barbarian tribes (see FRANCE: *Early History*). By the end of the 5th century the Merovingian king Clovis I (q.v.) had been converted to Christianity, which spread throughout the kingdom and provided themes and inspiration for French artists and architects for many centuries. Examples of art from the Merovingian period are rare. Only a few architectural ruins, illuminated manuscripts, and sculptured monuments remain. These remains reflect some Roman influence, particularly in architectural design, but in con-

trast to Roman tradition their decorative details include spirals, interlaced patterns, and insets of pieces of colored glass more in the style of barbarian work.

At the beginning of the 9th century the Carolingian king Charlemagne (q.v.) aspired to build an empire emulating that of Rome. He initiated a revival of interest in classical culture, reflected in the art and architecture of his time. Although atypical, the most notable example of Carolingian architecture was Charlemagne's palace chapel at Aachen (q.v.), known in French as Aix-la-Chapelle. In Carolingian painting, sculpture, and mosaic, the human figure became more important than in Merovingian art and was treated according to Roman tradition. An outstanding example of this style is the portrait of an evangelist in a book of the Gospels found in Charlemagne's tomb.

ART

The classicism of the Carolingian revival gradually gave way to a new style more compatible with the merging spirit of medievalism.

Romanesque Art. The new style, known as Romanesque, reflected many influences other than those of Rome, including Byzantine, Saracen, and barbarian (see BYZANTINE ART; SARACENS). Variations of the style are found not only in the different regions of France, but also in Italy, Germany, England, and Ireland (see ROMANESQUE ART AND ARCHITECTURE). The style found its principal expression in architecture (see *Architecture*, below); architecture, in turn, influenced sculpture and other art forms. Romanesque sculpture was often executed as an integral part of a church building and therefore subordinated to architectural requirements. An example of French Romanesque sculpture is "The Mission of the Apostles" in the abbey church in Vézelay, a relief which dates from the 12th century. Painting in this period was limited to frescoes, characterized by a strong linear treatment and an emphasis on design. A uniquely French artistic development of the Romanesque period was the invention of the type of enamelwork called Limoges (q.v.), which was used in portable altars, shrines, and other articles of church furniture.

Gothic Art. The Romanesque style evolved into the Gothic style around the middle of the 12th century. Like the Romanesque, the Gothic began as an architectural development and thus provided the setting and inspiration for the later evolution of Gothic sculpture and painting (see GOTHIC ART). One of the most distinctive examples of the French Gothic style is the work of the miniaturists of the late 13th century, who

"The Annunciation", a miniature from the early 15th-century prayer-book Les Très Riches Heures of Jean de France, Duc de Berry. Metropolitan Museum of Art—Cloister Collection



imitated the forms and rhythms of Gothic carved ornament, as in the "Breviary of Philippe le Bel" (Bibliothèque Nationale, Paris). In this work, executed in 1295, the figures are curved and contorted. Because many French sculptors were employed in Tuscany in northern Italy, the influence of northern Italian artists was reflected in the French works of the entire 13th century.

Paintings, of which the "Retable of Thouzon" (late 14th cent., Louvre, Paris) is an example, are in the manner of the Sienese or northern Italian school. The greater part of the 14th century, disrupted by the Hundred Years' War (q.v.), produced little outstanding work, and much of that which was produced was destroyed in the wars

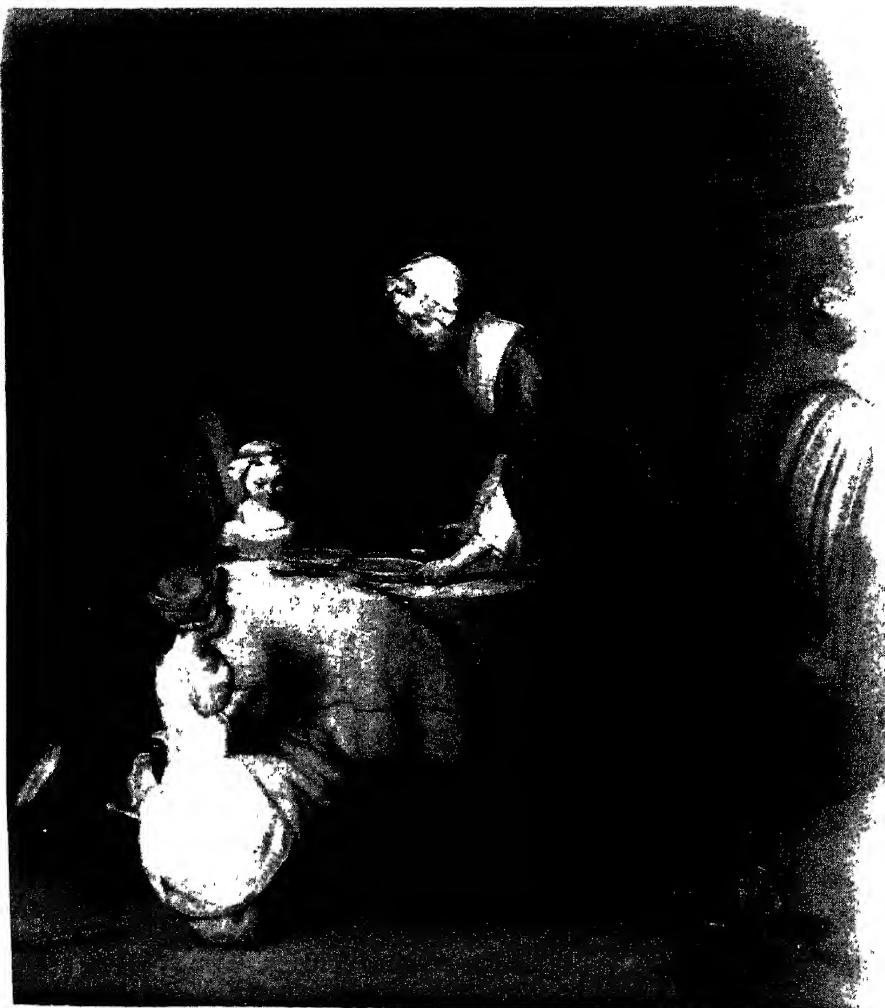
that followed. An exceptionally fine work that survived is the grisaille, or monochromatic gray painting, on silk known as the "Parement of Narbonne" (about 1375, Louvre); it is characterized by tortured lines typical of late northern Gothic rather than the Sienese school. At the end of the 14th century the Flemish-born French miniaturist and sculptor André Beauneveu seems to have enjoyed a great reputation. A sketchbook executed in his style, but perhaps not actually by Beauneveu himself, is in the J. Pierpont Morgan Library, New York City; it was probably a member of Beauneveu's group who painted the "Wilton Diptych" (National Gallery, London). The most famous of the miniatures of this period is the "Book of Hours of the Duc de

FRENCH ART AND ARCHITECTURE



Above: "Eleazar and Rebecca" (1648) by Nicolas Poussin. Left: "The Benediction" (1740) by Jean Baptiste Siméon Chardin.

Archives Photographiques,
Paris



Berry" (Musée Condé, Chantilly); painted about 1416 by the Flemish painter Pol Limburg and his brothers Hermann and Jan.

15th- and 16th-Century Art. Under the dukes of Burgundy, whose court was at Dijon, the arts were encouraged and foreign workers were employed. Among these was the Dutch sculptor Claus Sluter, who introduced the important tradition of placing weeping stone figures on tombs. The "Pietà" (Louvre) by the Flemish-born painter Jean Malouel or Jean Maelweel (d. 1419) is a work showing more of the Sienese influence than of the late Gothic. The unsigned "Annunciation", the central panel of which remains in the Church of the Magdalen at Aix-en-Provence, shows the influence of the Flemish painters Hubert van Eyck and Jan van Eyck upon its unknown painter; see FLEMISH ART AND ARCHITECTURE.

One of the most interesting painters of the 15th century is Jean Fouquet, who produced many miniatures. Forty of these, from the "Book of Hours of Étienne Chevalier" (Musée Condé, Chantilly), show how thoroughly Fouquet assimilated the Florentine tradition into his Gothic background; see FLORENTINE PAINTING AND SCULPTURE.

The first group of painters who may be said to constitute a separate French school were those working in the vicinity of Avignon, of whom Fouquet was one. The names of most of these artists have not been preserved. One of them, the religious painter Enguerrand Charonton or Enquerand Quarton (1410?-after 1466), is represented by the "Virgin of Mercy" (1452, Musée Condé) and by his magnificent "Coronation of the Virgin" (1453-54, Hospice de Villeneuve-les-Avignon). An unknown member of this group produced the "Pietà de Villeneuve-les-Avignon" (Louvre), one of the first works to achieve a true synthesis of the northern and southern styles.

17th-Century Art. Italian fresco painters employed by Francis I (q.v.), King of France, to decorate the palace of Fontainebleau during the first half of the 16th century had an extensive influence upon French art. This influence reached its peak in the early part of the 17th century in the works of the court painter Simon Vouet (1590-1649). See RENAISSANCE ART AND ARCHITECTURE: *Western and Central Europe*.

The most influential artist of the 17th century was Nicolas Poussin, who worked mostly in Rome, and who derived compositions and atmosphere from the works of the Italian Renaissance painters Raphael and Titian. The work of Poussin, although of individual genius, was essentially French. Another important artist,

Claude Lorrain, painted landscapes that are among the most pleasing works of the Renaissance. Poussin's brother-in-law, Gaspard Dughet (1613-75), was known as Gaspard-Poussin; he combined elements derived from the works of two older contemporaries, Poussin and Lorrain, in painting his classical and unpretentious landscapes. The insistence of Nicolas Poussin upon architectural order in the construction of a painting was influential upon works such as "The Return of the Ark" (National Gallery, London), by Sébastien Bourdon (1616-71). The style of the last quarter of the 17th century was largely determined by the conflict between those artists who believed that supremacy in art required imitation of Poussin and his emphasis on line and other artists who supported the Flemish artist Peter Paul Rubens and his emphasis on color.

18th- and 19th-Century Art. Jean Antoine Watteau followed the style of Rubens but imbued his work with a completely different spirit. His portrayal of the French aristocracy, often in idealized pastoral settings, is playful and worldly yet with an undertone suggesting the fundamental helplessness of the people he portrays and the emptiness of their activities. Watteau's manner was adopted by many painters, who turned out hundreds of what are often called *boudoir* paintings.

Jean Baptiste Siméon Chardin, perhaps the greatest French painter of the 18th century, found his subject matter in the lives of ordinary people. He painted domestic scenes and still lifes. The tradition of Watteau continued in the light and graceful work of Jean Honoré Fragonard.

The 18th-century fascination with airy prettiness had vanished before the appearance of Jacques Louis David, a revolutionary in painting as well as in politics. He rejected the elegance of François Boucher, Nicolas Lancret, and the other followers of Watteau, and from fragments of antique sculpture and vase painting assembled heroic pictures such as "The Vow of the Horatii" (Louvre). David's pupil Jean Auguste Dominique Ingres insisted upon an absolute fidelity to nature. One of the most scrupulous of French draftsmen, Ingres could manage the arrangement of a multitude of forms, as in "Turkish Bath" (Louvre), as his master could never have done.

The Romantic movement in French painting may be dated from the exhibition in 1819 of "The Raft of the Medusa" (Louvre) by Jean Louis André Théodore Géricault. The death of Géricault at the age of thirty-three left the leader-



"Luncheon in the Open Air" by Édouard Manet.

Archives Photographiques, Paris

ship of the Romantics to Ferdinand Victor Eugène Delacroix, although Delacroix refused to accept the idea that he was head of a Romantic school, insisting that his work was classical. One of the great influences upon the Romantic painters was the work of the British landscape artist John Constable, some of whose pictures were exhibited in Paris in 1824. It is reputed that after seeing these paintings Delacroix completely repainted his "Massacre at Chios" (Louvre). The realism of Ingres and the opulence of Delacroix are combined in the murals of Théodore Chasseriau (1819–56) in the Cour des Comptes in the Palais d'Orsay.

The first great French landscape painter of the 19th century, Jean Baptiste Camille Corot, reflected the grand manner of Claude Lorrain in his well-constructed earlier paintings; later, in an attempt to achieve the same effects of light and shadow as the camera, Corot produced innumerable works containing the feathery trees commonly associated with his name. The charm of his figure paintings is shown in works such as "Young Woman with a Pearl Ring" (Louvre). The other painters of the Barbizon School (q.v.),

Théodore Rousseau (1812–67), Charles François Daubigny, and Henri Harpignies (1819–1916), thought that by painting out of doors they were returning to nature. Their pictures, however, remain studio pictures. The true precursors of impressionism (q.v.) are minor figures such as Eugène Louis Boudin (1825–98), in whose paintings it is possible to tell the time of day at which the painter executed them, and Johann Barthold Jongkind, a Dutch artist resident in France.

Gustave Courbet began his career as a Romantic, but later became a realist, expressing in his paintings the same ideals that his friend the French author Émile Zola expressed in his novels. Now recognized as one of the great painters of his time, Courbet was much concerned with social problems and was one of the leaders of the revolutionary Commune of 1871 (q.v.).

The first in a line of distinguished French artists of the 19th century who were engrossed in capturing all the eccentric characteristics of their models was Honoré Daumier. In his paintings Daumier exaggerated these peculiarities to the extent of caricature. Among his successors were Constantin Guys (1802–92), the witty chronicler of elegant Paris life in pen and ink, and the painter Henri de Toulouse-Lautrec,

who recorded the life of the cafés and the race-tracks with a sharpness that has seldom been equaled.

Impressionism and 20th-Century Painting. The first French artist to free himself completely from the influences of Poussin and the Italians was Édouard Manet, whose earlier paintings are in the manner of Courbet. Manet's "Luncheon in the Open Air" (1863, Louvre) raised a storm of controversy with its realistic depiction of nude females and clothed males.

Claude Monet had already been impressed by the paintings of Boudin when he visited London during the siege of Paris in the Franco-German War (q.v.) of 1870–71. In company with Camille Pissarro, Monet examined the paintings of the British landscape artist Joseph Mallord William Turner in the National Gallery, making the discovery that Turner had used the primary colors, finely stippled, to reproduce the dazzling whiteness of snow. This discovery may be said to have contributed decisively to the development of impressionism (q.v.). Pissarro, though less talented than Monet, had great influence upon the painters of succeeding generations. Alfred Sisley, born in Paris of British parents, was a remarkably sensitive painter who employed larger brush strokes than most of the impressionists.

The most extraordinary of the impressionists was Georges Seurat. In accordance with his theory that everyone could learn to paint well, Seurat constructed his figures from certain geometric forms and minute dots of color. In "The Circus" (Luxembourg Museum) and "A Sunday Afternoon on the Island of La Grande Jatte" (Art Institute of Chicago), his figures appear curiously immobile. The geometrical precision of his work has had a great influence upon succeeding painters.

Hilaire Germain Edgar Degas was the master of portraying the human body in unusual positions. As might be expected from a pupil of Ingres, Degas was a great draftsman. His elaborate compositions are skillful arrangements of unexpected forms. His own pupil, the American-born Mary Cassatt, showed an extraordinary tenderness in her paintings of mothers with infants.

Pierre Auguste Renoir, a supreme painter who worked from no theoretical basis, concentrated on the problem of conveying the evanescent quality of flickering light upon flesh.

Paul Cézanne's concern with the organization of forms into a coherent whole was even greater than that of Seurat; Cézanne expressed his wish "to do Poussin over again from nature", to find in nature a system as formal and orderly as that



"Boy in a Red Waistcoat" (1890–95) by Paul Cézanne.
Museum of Modern Art—Gift of David Rockefeller

of the classical masters. His successors borrowed from Cézanne his mastery of the simplification of form. Vincent van Gogh, a Dutch artist resident in France, painted the everyday things around him with an intensely personal and visionary fierceness. Paul Gauguin, interested in reproducing the flat patterns and bold outlines of stained glass, as in his "Jacob Wrestling with the Angel" (National Gallery of Scotland, Edinburgh), found van Gogh's brilliance of color and simplicity of form in the tropical atmosphere of Tahiti.

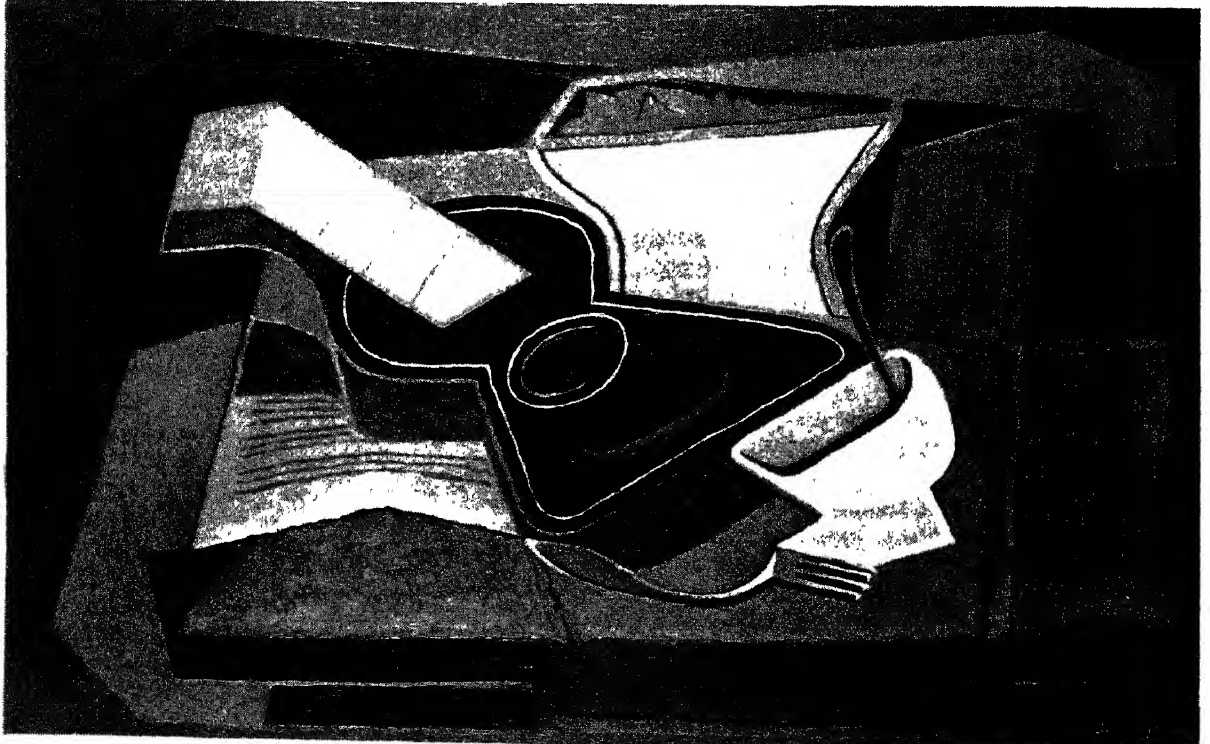
The freedom in form and color explored by Cézanne, van Gogh, and Gauguin was carried further by the Fauvist movement of 1905–06; see FAUVISM. This movement included such important 20th-century painters as Henri Matisse, Georges Braque, Georges Rouault, and André Derain. Cézanne's angular arrangement of shapes was carried to its logical conclusion in cubism (q.v.), which was begun about 1907 by Braque and Pablo Picasso. Beginning with the early years of the 20th century it was impossible to discuss French painting without mentioning the many artists, not French by birth, who contributed to the school of Paris. For example, although Spanish by birth, Picasso must be considered a French painter; his influence upon other painters was probably greater than that of any other artist, with the possible exception of Raphael. Other prominent cubists were Juan Gris and Fernand Léger.



Baltimore Museum of Art — Cone Collection

Parke-Bernet Galleries

Left: "Purple Robe" (1937) by Henri Matisse. Below. "The Black Guitar" (1926) by Juan Gris. Although Spanish by birth, the artist is a principal member of the French cubist movement



FRENCH ART AND ARCHITECTURE

About 1923 André Breton founded surrealism (q.v.) in Paris, describing the works produced as the results of "pure psychic automatism". Besides Picasso, who participated in every movement after cubism, the prominent painters of the surrealist school included Salvador Dalí and Joan Miró, both Spanish, Jean Arp and André Masson (1896–), who were French, the German artist Max Ernst, and Yves Tanguy, a French-born American artist.

Some painters have worked apart from all these movements. Georges Rouault, although a Fauvist for a short while, continued his individual exploration of the use of color confined within strict heavy outlines, as in medieval stained-glass windows. Pierre Bonnard painted his individualistic scenes in a manner deriving from the impressionists, as did Jean Édouard Vuillard (1868–1940). The primitive painter Henri Rousseau had considerable influence with apparently naïve paintings, such as "The Sleeping Gypsy" (Museum of Modern Art, New York City). Rousseau employed brilliant colors and careful arrangement of forms. Maurice Utrillo painted the streets of Paris affectionately and with brilliance. The Italian Amadeo Modigliani produced elongated figures in a highly in-

dividual style. Jean Hélion (1904–) was at one time the leader of the French abstract school, composed of followers of the Dutch painter Pieter Mondriaan; in his later works Hélion turned to romantic landscapes and scenes. See also ABSTRACT AND NONOBJECTIVE ART.

ARCHITECTURE

Little of French architecture before the beginning of the 11th century is still in existence, although the abbey church of Saint Martin, Tours, was begun about 997 and the abbey church of Cluny was dedicated in 981. Both these churches are in the style known as Romanesque, and their many small chapels are the results of the increase of the veneration of the saints with the consequent need for more altars. The highest development of the Romanesque is that style known as Norman, illustrated by churches such as Saint Stephen's in Caen. The Norman style had its full flowering in England in the cathedrals of Ely and Winchester. Several distinct local schools developed in France. Those of Provence and Aquitaine preferred churches without aisles. The aisles in the churches of Auvergne usually have galleries. In Burgundy the Italian tradition of the basilica prevailed. Possibly the supreme example of pure

Cathedral at Bayeux, Normandy. Although the church was originally built before the 11th century, the present edifice is an example of Gothic architecture at its height.

French Government
Tourist Office





The grand staircase of the Paris Opera (1861–75), a neo-baroque structure known for its heroic sculpture, grand facade, and elaborately decorated interior.

French Government Tourist Office

Romanesque architecture in France is the cathedral of Saint Front, Périgueux, completed about the middle of the 12th century.

The Gothic style appears for the first time in the choir of the abbey church of Saint Denis, near Paris, which was consecrated in 1144. Most of what is known of the mechanics of French architecture of the early 13th century seems to come from a textbook prepared about 1235 by the architect Villard de Honnecourt, giving a general idea of the problems entailed in lifting heavy weights and of the intricacies of timber construction. Following the construction of St. Denis, the building of Gothic cathedrals began all over France. The magnificent Notre Dame in Paris was started about 1163. The Gothic style in France attained its peak during the 15th century.

The Renaissance reached France with the building of the palace of Fontainebleau under the Italian architect Sebastiano Serlio (1475–1554). Serlio also wrote a French treatise on architecture, published in Lyon. Classical Italian forms are combined with native French forms in the facade of the Louvre (q.v.) that faces the court. The famous ornate southern half of the court's west side was designed in 1546 by Pierre Lescot (1510?–78). Although a few notable churches were erected during the 17th century,

more important work was done in domestic architecture, notably the *cour d'honneur* or formal courtyard at Blois, designed by Nicolas François Mansart, and in the eastern front of the Louvre, designed in 1665 by Claude Perrault (1613–88). Built toward the end of the century, the church of Saint Louis des Invalides, Paris, shows an elegant blending of the baroque with the classical. It was designed by Jules Hardouin-Mansart (1646–1708), who was also responsible for the garden front of the Palace of Versailles (see VERSAILLES). The elegance of the 18th-century *hôtels*, public buildings such as hospitals and city halls, is well exemplified by the Hôtel Matignon, Paris, designed in 1726 by Jean Courtonne (1671–1739). The influence of Spanish architecture, apparent in the design of the staircases of the Tuileries (q.v.) by Louis Le Vau (1612–70), became common in all domestic architecture throughout the century.

Claude Nicolas Ledoux (1736–1806) was an eccentric architect who planned pyramidal and spherical houses. In his designs for the city gates of Paris, made between 1784 and 1789, he showed a preference for the squat Doric column (see DORIC ORDER). The influence of Ledoux was considerable both in England and in Germany. Although the architecture of the 19th century is often merely repetitious of older styles, the Opéra in Paris, built between 1861 and 1874 by Jean Louis Charles Garnier (1825–98), is an excellent example of neobaroque, hav-

Intricate Gothic sculpture covers the 14th-century portal of the Strasbourg Cathedral.
French Government
Tourist Office



ing a spectacular exaggeration of ornament derived from Italian models. One of the most remarkable works of the century, the iron Eiffel Tower (q.v.) in Paris, was the work of the engineer Alexandre Gustave Eiffel.

The style known as Art Nouveau, with its twisted neobaroque ornament and showing the obvious influence of the Far Eastern arts, became popular in the 1890's. At the turn of the century an appreciation of the possibilities of concrete as a building material was shown by two architects, Tony Garnier (1869–1948) and Auguste Perret (1873–1955). The greatest theoretician of modern architecture was Le Corbusier, a Swiss resident in Paris, whose work *Vers une Architecture* (1923; Eng. trans., *Towards a New Architecture*, 1959), has been an influence upon architects all over the world.

SCULPTURE

The early history of sculpture in France is closely connected with that of architecture, developing from the decoration of columns and doorways of churches and cathedrals during the 10th and 11th centuries. By the 13th century, with the

tombs of Saint Denis and the west and north porches of the Cathedral of Notre Dame in Chartres (see CHARTRES), French sculpture had become established and was an influence throughout Europe.

During the Renaissance, however, the influence of the great Italian sculptors tended to overshadow the French. Not until the middle of the 16th century, with Jean Goujon (1520–66), and the century following, with Pierre Puget and François Girardon (1628–1715), was any outstanding work produced. In the 18th century the French sculptor Jean Antoine Houdon was an outstanding portrait artist. He went twice to America where he executed portraits of President George Washington, Benjamin Franklin, and the naval officer John Paul Jones. François Rude, in his relief called the "Marseillaise" on the Arc de Triomphe in Paris, showed a vigor that distinguished him from the rigid classicism of his day. Antoine Louis Barye was known for his innumerable statues of animals.

The greatest French sculptor of the 19th century was Auguste Rodin, a destroyer of the class-



"Eve" (1881), lifelike, white-marble sculpture by Auguste Rodin.

Art Institute of Chicago—
Mr. and Mrs. Martin A. Ryerson Collection

cal traditions that hampered freedom of expression. He was also an impressionist, and his portraits show a vivid appreciation of the essential qualities of his models.

In the 20th century, Aristide Maillol showed his devotion to classicism in his monumental figures, as did Charles Despiau (1874–1946). The cubists included Henri Laurens (1885–1954), Raymond Duchamp-Villon (1876–1918), and the Russian-born Jacques Lipchitz, a French citizen from 1925 to 1958. Amedeo Modigliani, an Ital-

ian working in Paris, carved long, slender faces that have much in common with the pure abstractions of the Rumanian Constantin Brancusi. Most of the surrealists were sculptors at one time or another. Among the most persistent of them were Jean Arp, who produced a series of vast white plaster shapes called "Human Consecrations", and the Swiss Alberto Giacometti, with his wood, wire, and string constructions and his elongated plaster figures.

See also biographies of the artists mentioned without their birth and death dates.

FRENCH BROAD, river of North Carolina, rising in Transylvania Co., near the foot of the Blue Ridge Mts. It flows north past Asheville and then northwest into Tennessee, where it joins the Holston R. 4 mi. above Knoxville to form the Tennessee R. The total length of the French Broad R. is about 250 mi. The river valley between Asheville and the Tennessee boundary is noted for scenic beauty.

FRENCH CAMEROONS. See CAMEROON, UNITED REPUBLIC OF.

FRENCH COMMUNITY. See COMMUNITY, THE. **FRENCH EAST INDIA COMPANY**. See EAST INDIA COMPANY: *French East India Company*.

FRENCH EQUATORIAL AFRICA, former French possession in Africa, comprising four of the autonomous republics in the French Community (see COMMUNITY, THE), namely the Gabon Republic (q.v.), the Republic of Congo (see CONGO, REPUBLIC OF), the Central African Empire (q.v.), and the Republic of Chad (see CHAD, REPUBLIC OF). The area of the former possession was 969,111 sq.mi.; the chief city and the capital was Brazzaville (now capital of the Republic of Congo).

HISTORY

The coast of French Equatorial Africa was discovered by the Portuguese in 1470. French settlements were established on the estuary of the Gabon R. in 1839, and the seaport town of Libreville was founded nine years later. In 1862, with the acquisition of Cape Lopez (Port Gentil), the French commanded a coastline of 200 mi. Military expeditions and journeys of exploration, including those of the American explorer Paul Belloni du Chaillu (q.v.) and the French explorer Pierre Paul François Camille Savorngnan de Brazza (1852–1905), extended French rule to the northeast, until, by a series of conventions held among various European powers between 1885 and 1886, the limits of French Equatorial Africa (known until 1910 as the French Congo) were fixed. Until 1894, France, Great Britain, and the Congo Free State were involved in frequent disputes over alleged encroachments upon their



Aerial view of the harbor section of Brazzaville, capital of the Republic of Congo.
French Overseas Ministry

respective territories (see ZAIRE, REPUBLIC OF). At length, France adjusted its claims with the Congo Free State by a convention of 1885, and settled its differences with Great Britain in 1899 by establishing the eastern boundary of French Equatorial Africa with the exception of a region in the vicinity of Darfur, Anglo-Egyptian Sudan, the border of which was finally demarcated in 1924 (see SUDAN, REPUBLIC OF THE). In 1910 French Equatorial Africa, although retaining administrative identity, was divided into three colonies, Gabon, Middle Congo, and Ubangi-Shari-Chad. Pursuant to a convention of 1911, France ceded 107,270 sq.mi. of territory in French Equatorial Africa to Germany in exchange for German recognition of the French protectorate in Morocco and cession to France of 6450 sq.mi. of territory in the German Cameroons. Following World War I, the African territory previously ceded to Germany was returned to France, and again included in French Equatorial Africa. In 1920 Ubangi-Shari-Chad was further divided into the colonies of Ubangi-Shari and Chad, thereby increasing to four the number of constituent colonies making up French Equatorial Africa.

Soon after the defeat of France by Germany in World War II (June, 1940), most of French Equatorial Africa allied itself with the Free French forces under General Charles de Gaulle (q.v.), and General Edgard de Larminat (1895–), General de Gaulle's agent, replaced the pro-Vichy governor-general at Brazzaville. Adminis-

trative officials at Gabon who maintained their loyalty to the Axis-oriented Vichy regime were ousted when the Free French took Lambaréné, Libreville, and Cape Lopez in a brief campaign. During World War II French Equatorial Africa was strategically important as an overland route to the military sectors of the Middle East, and as a base of operations for the Free French.

On Oct. 16, 1946, pursuant to the constitution of the Fourth French Republic, each of the colonies became an Overseas Territory of the French Union (q.v.). French Equatorial Africa as a whole was placed under the administration of a governor-general, and governors were appointed to administer each Overseas Territory. Suffrage was extended gradually but steadily to the indigenous population. In the period from 1946 to 1952 the number of voters rose from about 111,000 to 778,256. The postwar economic situation was generally favorable. Steady increases in production were recorded, notably in timber, cotton, sisal, palm oil, and palm kernels. In 1953 the discovery of manganese deposits paved the way for development of a mining industry. Two giant hydroelectric dams were dedicated in 1954. One of the dams supplied power for refineries processing one third of the French bauxite output. In 1956 deposits of potash, iron ore, and petroleum were discovered. The 1957 elections to the Territorial assemblies were the first under

FRENCH ESTABLISHMENTS IN INDIA

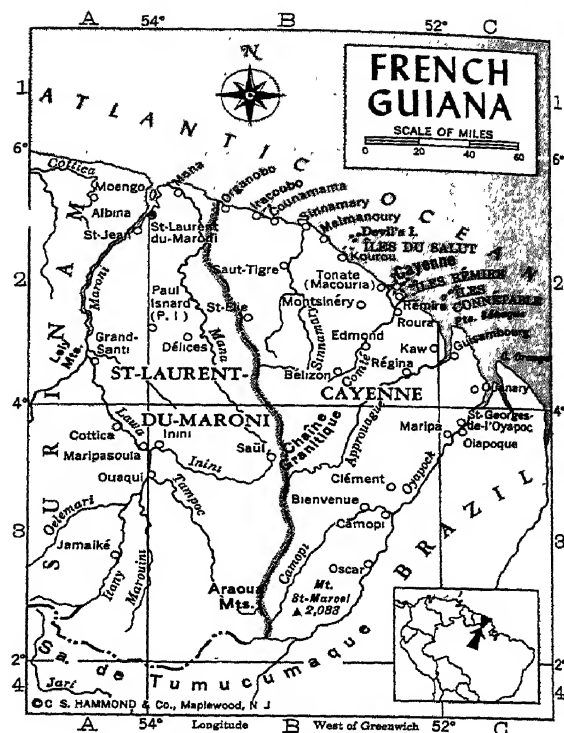
universal suffrage. In a referendum held on Sept. 28, 1958, the four Territories approved the constitution of the Fifth French Republic (see FRANCE: History: The Fifth Republic). French Equatorial Africa ceased to exist in early 1959 when the four new republics were officially proclaimed. All four republics were declared fully autonomous, while remaining within the French Community, in August, 1960.

FRENCH ESTABLISHMENTS IN INDIA. See FRENCH INDIA.

FRENCH GUIANA, overseas department of France, situated on the N.E. coast of South America. It is bounded on the N by the Atlantic Ocean, on the E. and S. by Brazil, and on the W. by Surinam (Dutch Guiana), and includes the Îles du Salut or Safety Islands, of which Devil's Island (q.v.) is the best known. French Guiana is the oldest of the overseas possession of France and the only French territory on the American mainland. The capital, chief town, and main port is Cayenne (q.v.), which had a population of 18,010 in 1967. The interior section (area 27,020 sq.mi.) of the territory, which is under separate administration, is called Inini.

French Guiana lies in the equatorial forest zone of South America. It is separated from Brazil by the lofty Tumucumaque mountain range on the S. and by the Oyapock R. on the E. The Maroni, Itany, and Lawa rivers mark its boundary with Surinam on the W. The land rises from the low marshy coastal areas in the N., called the *terres basses*, through the broad central plateau, covered by dense tropical forest, to the *terres hautes*, or highlands, which ascend from foothills to the Eurepoucigne and Oroye ranges in the extreme south. The territory is well watered by numerous rivers which rise in the mountains and course northward to the Atlantic. The climate of French Guiana is tropical, with a mean annual temperature of 80° F. in the coastal zone. Cool, onshore breezes fail to mitigate the enervating humidity. The short, dry season from June to November is succeeded by a period of torrential rains achieving maximum intensity in the months of April and May. Trade winds blow from the N.E. in summer and from the S.E. in winter.

Native Indians, descended from the aboriginal Arawak, Carib, and Tupi-Guarani tribes (qq.v.), inhabit the remote interior of French Guiana. Virtually untouched by European civilization, they preserve their ancient tribal customs. Along the waterways are the settlements of the Saramancas, Boeschs, and Bonis, whose forebears were fugitive Negro slaves. Their services as guides are much in demand.



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The extensive forest of French Guiana, covering approximately four fifths of the entire land surface, are rich in timber of commercial importance. Only about 15 sq.mi. out of a total area of 34,740 sq.mi. are devoted to agriculture. The crops chiefly cultivated are corn, rice, cassava, sugarcane, pineapples, yams, and bananas. The principal industry is placer mining for gold. Other mineral resources are silver, copper, iron, mercury, lead, mica, and bauxite. Industrial es-

establishments are small-scale, and include sawmills, rum distilleries, potteries, brickworks, and a dye factory. The chief imports are foodstuffs, gasoline and kerosene, manufactured products, metals, and machinery. Articles of export include commercial woods, rosewood essence, gold, bananas, cacao, rum, and mounted butterflies.

French Guiana is administered by a prefect, who is assisted by a council general, consisting of fifteen elected members. The department is represented in the legislative bodies of the French Republic.

History. The first French settlement on the Guiana coast was established in 1763. Captured by the Portuguese and the British in 1809, the colony was restored to France between 1814 and 1817. In 1852 it was made the site of a penal colony. Because of the unsavory reputation French Guiana thus acquired, attempts at colonization were generally unsuccessful. In 1938 penal servitude in French Guiana was abolished. After the fall of France in World War II (June, 1940), the local administration of French Guiana, despite strong popular sentiment in favor of the Free French (q.v.) movement under General Charles de Gaulle (q.v.), proclaimed its allegiance to the pro-German Vichy regime of Marshal Henri Philippe Pétain (q.v.). On March 18, 1943, however, the Vichy-oriented authorities in French Guiana were expelled by a pro-Allied committee which had the support of the French military forces and the majority of the population of the colony. Vichy decrees aimed at the suppression of democratic rights were revoked, political prisoners were liberated, and minor pro-Vichy officials were removed from the administration. The Allied blockade of French Guiana was lifted, and trade was resumed with the United States, Brazil, and the British and Dutch possessions in America. The territory became an overseas department of France on March 19, 1946. Total area of French Guiana, about 34,740 sq.mi.; pop. (1967) 44,392.

FRENCH GUINEA. See GUINEA.

FRENCH HORN. See HORN.

FRENCH INDIA, former overseas territory of France, comprising four enclaves on the Indian subcontinent known officially as *Établissements Français de l'Inde* ("French Establishments in India"). In descending order of size the enclaves, called *villes libres* ("free cities"), were Pondicherry (q.v.), Karikal, and Yanaon, all on the southeast coast; and Mahé on the southwest coast. Pondicherry Commune was the territorial capital.

Chandernagor (pop. in 1941, 38,284; area,

about 4 sq.mi.), a former territorial enclave situated 12 mi. north of Calcutta, was ceded to the Indian Union in 1950 as the result of a popular referendum held in the free city the previous year and became part of the State of West Bengal. In October, 1954, the city councilors of Pondichéry, Karikal, Yanaon, and Mahé voted (170 to 8) to merge with the Indian Union. France relinquished authority over the four enclaves on November 1 and, after ratification of a formal treaty of cession in 1956, they became the Union Territory of Pondichéry (see PONDICHÉRY). The total area of the French enclaves, excepting Chandernagor, was 196 sq.mi. and at the time of cession the population was about 318,400.

History. The first voyage by a French vessel from France to India and back was completed in 1615. The gradual development thereafter of French trade with India led, in 1664, to the establishment by royal charter of the *Compagnie des Indes Orientales*, known generally as the French East India Company; see EAST INDIA COMPANY: *French East India Company*. The company established trading posts in India, chiefly along the southern coasts, and attempted to develop commerce in rivalry with British interests, which were organized in the English East India Company. During the late 18th and early 19th centuries the colonies were seized three times by the British in the course of warfare arising from commercial rivalry; each time they were returned to France and, after 1814, they were administered by the French government until they were ceded to India.

FRENCH INDOCHINA. See INDOCHINA.

FRENCH LANGUAGE, language of the people of France. It is also spoken in parts of Belgium and Switzerland, and in present and former French colonies, including French Guiana, northwestern Africa, Indochina, Haiti, Malagasy Republic, and parts of Canada. For Breton, a Celtic language also spoken in parts of France, see BRETON LANGUAGE AND LITERATURE. French belongs to the Romance language group of the Italic subfamily of the Western division of Indo-European languages (q.v.).

Origins. The ancient Gauls, or Celts (q.v.), the earliest inhabitants of Gaul, or present-day France, spoke a primitive Celtic language from which Irish, Welsh, Breton, and other modern Celtic languages were derived (see CELTIC PEOPLES AND LANGUAGES). Celtic gave way, after the conquest of Gaul in the 1st century B.C. by the Roman general and statesman Gaius Julius Caesar (q.v.), to the form of Latin used by the uneducated classes in Rome and known as the *lingua vulgaris* in contrast to the *sermo urbanus* used

FRENCH LANGUAGE

by writers and orators. By the end of the 4th century A.D. Latin had entirely replaced Celtic in Gaul. The Celtic tongue spoken in the modern French region of Brittany (q.v.) is not a survival of the pre-Roman native culture; it is believed to have been brought there by Celtic inhabitants of the British Isles who took refuge in Brittany from the invasions of Britain by the Angles, Jutes, and Saxons in the 5th to 7th centuries A.D. Several words of purely Celtic origin, about fifty in all, have passed into modern French, including Celtic-Latin, *alauda*, modern French, *alouette* ("lark"); and Celtic, *carruca*, Celtic-Latin, *carrus*, modern French, *char* ("car").

The *lingua vulgaris* was so firmly established in Gaul that the succeeding conquerors of the country, the German tribes, Visigoths, Burgundians, and Franks, did not impose their language upon the conquered territory; instead they adopted the language that they found there. In modern French only about 400 words are of Germanic origin, for example, *franc* ("free") and *français* ("French"), both from the Germanic word *Franko* ("freeman"); *fauteuil* ("armchair"), from the Germanic *faldastol*; and *auberge* ("inn"), from the Germanic *heriberga*. Greek words were also introduced into the *lingua vulgaris* at various times, beginning in the 6th century, through Greek colonies along the Mediterranean Sea, notably those at Marseille and Nice. By the 7th century the *lingua vulgaris* had been greatly modified by the people of France; the language spoken by them at that time was known as the Roman, or Romanic, language and was spoken by the upper classes as well as common people. As early as the 6th century, the homilies of the Church councils that took place in France were translated into Romanic, and in the 8th century the Frankish leader Charlemagne (q.v.) by royal edict ordered Church dignitaries to deliver their sermons in the popular tongue.

Evolution. In early medieval times the spoken languages north and south of the Loire R. began to develop separately. By the end of the 13th century they had become two distinct languages, the *langue d'oïl* of the North and the *langue d'oc* of the South; the terms were derived from *oïl* and *oc*, the words for "yes" in each of the languages. The chief phonetic difference in the two languages was their treatment of the free unaccented vowel *a* of Latin. The vowel became *e* in the *langue d'oïl*, but remained unchanged in Provençal, the principal dialect of the *langue d'oc*; thus, the Latin word *mare* ("sea") became *mer* in the *langue d'oïl*, and *mar* in Provençal. In each language several

dialects developed. In addition to Provençal, the principal dialects of the *langue d'oc* were the Gascon, Languedocien, Auvergnat, Limousin, and Béarnais. A great deal of poetry and other literary work was written in the *langue d'oc*; for a time, particularly in the 12th century, it seemed that it would establish supremacy over the *langue d'oïl*, but after the 12th century the *langue d'oc* rapidly became less important. In the 19th century efforts were made by a literary school known as *félibrige*, the chief members of which were the poets Frédéric Mistral and Joseph Roumanille (qq.v.), to revive the use of Provençal and other dialects of the *langue d'oc*; they were not successful, however, and the language is today a seldom-used dialect. The *langue d'oc* has contributed about 500 words to modern French, including *bague* ("ring"); *cadeau* ("gift"), and *velours* ("velvet"); see also PROVENÇAL LANGUAGE AND LITERATURE. The principal dialects of the *langue d'oïl* were named for the five northern provinces in which they were spoken: Île de France, Normandy, Picardy, Poitou, and Burgundy. After the accession of Hugh Capet (q.v.) as king of France in 987, Paris became the seat of government, and the language spoken there began to dominate other French dialects, as the court at Paris became politically important to provincial noblemen. Modern French has developed directly from the dialect of the Île de France, which gradually superseded other French dialects during the late Middle Ages.

In the 12th and 13th centuries the *langue d'oïl* was popular throughout Europe. It was the court language of Naples; German princes and barons maintained French-born tutors who taught it to their children, and in England for the two centuries following the Norman Conquest in 1066 French strongly rivaled English as the spoken language of the land and almost supplanted it as the literary language. In the Middle Ages a considerable number of Arabic words were added to the language, because of the prestige among French scholars of Arabic science and because Frenchmen brought the words back from Arabic lands that they had invaded during the Crusades. Among the words of Arabic derivation in French are *chiffre* ("number"), *cimetière* ("cemetery"), *girafe* ("giraffe"), *épinard* ("spinach"), and *jupe* ("skirt").

The 14th and 15th centuries, the period of the Hundred Years' War (q.v.) between France and England, which devastated French territory, gave popular impetus to French nationalism and to acceptance of the court dialect as a national linguistic standard. The 16th century brought a

great advance in linguistic development. In accordance with the Ordinance of Villers-Cotterêts (1539) of Francis I (q.v.), King of France, French as spoken in Île de France, especially in Paris, became the official language throughout the kingdom. In the second half of the 16th century, especially during the reign of Henry III (q.v.), King of France, from 1574 to 1589, a group of French poets known as the Pléiade (see PLEIAD), the chief members of which were the French authors Joachim du Bellay and Pierre de Ronsard (qq.v.), declared that French was the proper language for prose and poetry. The group conceded that the language required improvement, which they urged be brought about by modeling French writings on masterpieces from Greek and Latin literature. The principles of the Pléiade were embodied by Du Bellay in his *Défense et Illustration de la Langue Française* ("The Defense and Illustration of the French Language", 1549).

An International Language. The poet François de Malherbe (q.v.), through his poetic and critical works, succeeded in establishing a standard of exactness in the use of French words. That standard, followed later by most French writers, shaped the language into a sophisticated instrument for the clear, concise expression of thought. One of the most important steps toward standardizing and otherwise improving the French language was the compilation, in the 17th century, of a dictionary by the French Academy (see INSTITUTE OF FRANCE), a literary society formed in 1635 by the French statesman and cardinal Duc de Richelieu (q.v.). The Academy began the composition of an official French dictionary in 1639; the first edition appeared in 1694 and was followed in time by seven others; the eighth appeared between 1932 and 1935. In the reign (1643–1715) of Louis XIV (q.v.), King of France, the French language reached the highest point of importance in its history, becoming an international language in Europe, especially for diplomats and scientists.

By the 17th century the French language had developed into what is essentially its present form. Inflectional endings inherited from Latin had been for the most part dropped, and the language depended instead on prepositional phrases and word order to indicate syntactical relationships between words. Publication of the dictionary, widespread literacy, and the extensive use of printing all contributed to the stabilization of the language. Changes occurring later in French were virtually limited to the slow modification of pronunciation and to the addition of new words. The wars with Italy in the

first half of the 16th century (see FRANCE: *History: The Valois Dynasty*) had resulted in the introduction of about 800 words, for the most part of two types, those derived from the arts, such as *fugue* and *opéra*; and military terms, such as *colonel* and *soldat*. French wars with Spain in the early part of the 17th century enriched the French language with about 200 words, including *cigare* and *nègre*. French wars with Germany in the 17th century resulted in the introduction of a small number of words from the German, such as *blocus* ("blockage") and *cible* ("target"). A section of the newly founded (1795) Institute of France, successor of the old French Academy, issued an edition of the dictionary in 1798; the appendix of the work included a number of words that had been coined since the outbreak of the revolution. Among those that survive in the French language are *carmagnole* (q.v.), *divorcer* ("to divorce"), *guillotiner* ("to behead with a guillotine"), and *bureaucrate* ("bureaucrat").

In the early part of the 19th century, the exponents of French literary Romanticism inaugurated a movement to restore many archaic words to the language. That and a similar movement led by the Symbolist poets later in the century had little permanent effect on the language; see SYMBOLISTS. On the contrary, the whole tendency since the late 18th century has been to enrich the language with words dealing with new objects and concepts. Most additions to French since the late 19th century have come from one of two sources, the English language and technological or scientific terms. Among French words that have been taken from English and are spelled the same in both languages are *sandwich*, *square*, *ticket*, *toast*, and *weekend*; others given new spellings are *boxe* ("boxing"), *bouledogue* ("bulldog"), and *rosbif* ("roast beef"). Terms taken from technology include *automobile*, *jet*, *photographie*, and *télégraphe*.

In the 16th and 17th centuries French replaced Latin as a common language for international, especially diplomatic, communication in Europe, and it continues to be used for that purpose. With English, it is one of the two working languages of the United Nations (q.v.).

FRENCH LITERATURE, literature written in the language of France from about the end of the 11th century to the present day. Before the 9th century, Latin was the literary language of France. It was not until two centuries later that the first notable works written in French, the *chansons de geste* made their appearance. These works narrated heroic exploits and are, in fact, early forms of poetry; see EPIC POETRY.



The stories of Reynard the fox, from the 12th-century satirical poem *Le Roman de Renart*, became the basis for several other European literary works in the centuries that followed.

Medieval French Literature. The *chansons de geste* were long poems relating the deeds of Christian knights, and were composed possibly by wandering minstrels, known as *jongleurs*, to entertain pilgrims or the feudal courts. The authors of the *chansons* derived their inspiration from three main sources; accordingly their poems are classified as belonging to one of the three groups known, respectively, as the French, the Breton, and the Classical cycles.

The *Cycle de France* deals especially with the French heroes who put their arms at the service of religion. The central figure is Charlemagne, who is made the champion of Christianity. The most famous epic of this group, composed at the beginning of the 12th century, is the *Chanson de Roland* ("Song of Roland").

The *Cycle de Bretagne* (Brittany) is based largely on Celtic folklore. Its principal poet was Chrétien de Troyes, who lived during the latter part of the 12th century.

The *Cycle antique* is the least original and therefore the least important group. Turning to antiquity for their material, the authors Christianized Agamemnon, Achilles, Ulysses, and the heroes of Thebes, Troy, and Rome. The best-known work of this cycle is the *Roman d'Alexandre*.

Concurrently there existed a more popular literature of short stories in verse. At first these stories were concerned only with religious subjects, indicating the hold of the western Church over all literature. Later the Church monopoly of culture was broken when secular works by lay authors made their appearance. The *fabliau* (q.v.) flourished during the 12th and 13th centuries, and in this period appeared the satires *Le Roman de Renart* ("The Romance of Renart") and *Le Roman de la Rose* ("The Romance of the Rose").

Le Roman de Renart is an animal allegory of about 32,000 verses (later increased to 100,000), in which certain classes of contemporary society, including the clergy and nobility, are cautiously criticized. The way for this type of literature had been prepared by collections of ancient animal fables, particularly by a verse translation of selected fables by Marie de France during the 12th century.

Allegory is carried still further in the *Roman de la Rose*, a work in which the rose symbolized love and abstract ideas were personified. The first 4000 verses were composed by Guillaume de Lorris, and Jean de Meung, the pen name of Jean Clopinel (d. about 1305), added a further 14,000 verses. The influence of this poem per-

sisted throughout Europe well into the 17th century.

Encouraged by the academies that organized contests and awarded prizes, lyric poetry became increasingly popular, especially in the south of France. Unquestionably the greatest lyric poet of medieval France was François Villon, whose real name was François de Montcorbier. His two major works, *Petit Testament* ("Small Testament", 1456) and *Grand Testament* ("Great Testament", 1461), were composed in the form of burlesque wills. The *Grand Testament* was interspersed with ballads. Those works, which together comprise fewer than 2500 lines, introduced a vigorous self-expression into French poetry. They are self-revelations of a man with a lusty appetite for life, yet sharing the medieval sense of sin and preoccupation with death. Because of their expressiveness and individuality, Villon's poems have exerted a continuous influence over lyric poetry even into the 20th century.

The evolution of French medieval literature from religious to secular forms emerges most clearly in the theater. The *dramas liturgiques* of the 11th century were composed, in Latin prose, of sentences from the Bible. As a rule, they dealt with the Nativity and Passion of Christ. With the appearance of lay actors during the 12th century, the French language was adopted in the *drame profane* or *drame sécularisé*, which still employed episodes from the Bible. The scope was extended in the 13th century to include miracle plays about the saints and the Virgin. This period contains also the first pastoral play and comic opera, *Le Jeu de Robin et de Marion*

("The Game of Robin and Marion"). The miracle of the Virgin remained the favorite subject during the 14th century, and scenes from the chansons were further adapted for use in religious plays. In the succeeding century, popular interest in the theater increased, and theater production was freed from the influence of the Church.

Except for its historical interest, prose is of little importance in French literature before the 16th century. The long *Romans d'Aventure* ("Romances of Adventure") consisted merely of prose versions of the chansons.

Only a few of the historians need be mentioned, among them Geoffroi de Villehardouin (1150?-1218?) and Jean de Joinville, chroniclers of the Crusades; Christine de Pisan (1363?-1431?), author of graceful verse chronicles of the court; and Alain Chartier, verse chronicler of the disastrous Battle of Agincourt. All were overshadowed by Jean Froissart, whose *Chroniques* give a vivid picture of the age of chivalry. In the 15th century the *Mémoires* of Phillippe de Comines, whose ideas have much in common with those of his Italian contemporary, Niccolò Machiavelli, provide the first connected French account of political events from the point of view of a statesman.

Renaissance French Literature. In the 16th century French literature came under the sweeping influence of the Italian Renaissance. Petrarchan verse forms and classical concepts, particularly Platonic philosophy, gained enthusiastic acceptance; see RENAISSANCE. They were espoused at the court of Margaret, Queen of Navarre, which became the center of French culture of that period. Chief among the early French Renaissance poets was the 16th-century writer Maurice Scève, whose work reflects the intellectuality of the Renaissance. Unlike the intimate emotional expressiveness of Villon and of the later Pléiade poets, Scève's verse was a formalized expression of perception and knowledge. In this and in his obscure allusiveness he has a certain kinship with a major mode of 20th-century poetry.

In the poets of the next generation the Renaissance came to its full flowering. Seven poets, forming a group known as the Pléiade (see PLEIAD), under the leadership of Pierre de Ronsard, brought about a new literary era. Ronsard's widely imitated odes, sonnets (*Amours de Cassandre*, 1552), and his unfinished epic (*La Franciade*, 1572) made him the most famous poet of the century. Ronsard used the ancients as models, in accord with the poetic theories of Joachim du Bellay, second in importance among



A miniature depicts Narcissus at the fountain, a scene from the medieval allegory *Le Roman de la Rose* (14th-century manuscript).

In the Library of Ambroise
Firmin-Didot, Paris

FRENCH LITERATURE

the Pléiade poets. In the perfection of his poetic forms, Ronsard helped to prepare for the advent of classicism.

The new ideas of the Renaissance and especially the new concept of humanism made their first strong appearance in the writings of Fran-

The feeding of Gargantua, the giant hero of Les Grandes et inestimables Cronicques du grand et énorme Géant Gargantua by François Rabelais, an engraving by the 19th-century French illustrator Gustave Doré.

çois Rabelais. Of his five books, the most celebrated are *Pantagruel* (1532) and *Gargantua* (1534), epic stories of giants. Rabelais used the latter to personify the greater freedom and potentialities of humanism, which called for the full development of man's body and mind. He urged a broad morality, called Pantagruelism, dedicated to satisfying all the demands of human nature, as a rational acceptance of reality. Rabelais projects a realism, germs of which



are to be found in the medieval allegory *Le Roman de la Rose*, which was to reappear in the comedies of the 17th-century playwright Molière. One of the most powerful prose writers of France, Rabelais is remarkable for his vitality and inventiveness and for his boundless faith in the capacities of the human spirit.

Michel de Montaigne represents the supreme type of French humanist and scholar. He describes his *Essais* ("Essays", 1571–88) as a self-portrait, an exposé of his personal philosophy on all subjects that engage his attention. He recommends a mild but universal skepticism as the philosophic means for escaping frustration and disillusion and achieving contentment in life. His pedagogical system stresses an open-minded spirit of inquiry rather than an accumulation of facts. In politics and religion Montaigne is a conservative, seeking social as well as individual serenity. The *Essais* offer the first model of the *honnête homme*, that is, the cultivated gentleman of the 17th century.

The Classic Period in French Literature. The 17th century, known as *Le Grand Siècle*, is the classic period of French literature. It was marked by the long reign of Louis XIV, *le Roi Soleil* (the Sun King), during which France reached the apex of its power and influence in European politics and culture. A leading figure was François de Malherbe, who, although a mediocre poet himself, fixed the literary criteria of the century: pure reason, common sense, and perfection of manner. Two influences contributed to the acceptance of these standards, the salon of the Marquise de Rambouillet (1588–1665) and the Académie Française (see INSTITUTE OF FRANCE).

The Marquise de Rambouillet is regarded as the founder of so-called preciosity, a reform in language, manners, and wit. For all its affectation and exaggeration, later satirized by Molière in his *Les Précieuses Ridicules* ("Ridiculous Precieuses", 1659), it promoted refinements in language, feelings, and social relations. The Marquise de Rambouillet brought together in her salon the majority of the contemporary men of letters. The perennial question of content and form was the subject of the most notable literary controversy of the period. It was evoked by a critical discussion of two sonnets, "Job", by Isaac de Benserade (1613–91), and "Uranie", by Vincent Voiture. Other women influenced literary trends in that period, notably the Marquise de Maintenon.

Originally a private society of scholars, the Académie Française was transformed in 1635 into a state corporation, at the insistence of the statesman Cardinal Duc de Richelieu. It was

proposed that the Academicians prepare a dictionary, a grammar, and a work on rhetoric. Of these, the dictionary alone was completed and published. Much of the work on this lexicon was done by Claude Favre Vaugelas (1595–1650), whose *Remarques sur la Langue Française* ("Remarks on the French Language", 1647) did much to establish standards of usage. Among the other original members of the Académie were Valentin Conrart (1603–75) its first secretary, and the poets Jean Chapelain, François Maynard (1582–1646), the Marquis de Racan (1589–1670), and Vincent Voiture. Antoine Furetière (1619–88), who became a member in 1662, was expelled in 1685 for having compiled a dictionary (not published until 1690), upon what is now recognized to have been a more logical plan than that adopted by the Académie. See INSTITUTE OF FRANCE.

Nicolas Boileau-Despréaux was the principal literary theorist and critic of the classical age; his influence spread throughout Europe, affecting the work of such English masters as John Dryden and Alexander Pope. Believing in reason and natural law and fond of exact definitions, he sought to establish rules by which literature could be made a discipline as precise as science. His chief works, written in verse, are *Satires* (begun in 1660), *Épîtres* ("Epistles", begun 1669), and *L'Art Poétique* (1674; Eng. trans., *The Art of Poetry*, 1683).

A powerful literary influence was exerted also by Jacques Bénigne Bossuet, the most celebrated preacher of the age of Louis XIV. He was tutor to the dauphin and held a succession of high Church offices, becoming the principal spokesman for the Church in France. His sermons and his funeral orations (*Oraisons Funèbres*, 1689) are models of classic rhetoric.

Pierre Corneille was the first of the French masters of classic tragedy. His initial and greatest success was *Le Cid* (1636). Corneille sought to realize the Aristotelian unities of place, time, and action, but the dramatic tension in his tragedies is psychological, deriving from the aspirations and frustrations of his characters in their efforts to achieve greatness by supreme exercise of the will. Jean Baptiste Racine, who followed Corneille, is even more highly regarded. Less rhetorical and less formal, his work gained in naturalness; his later dramas were enlivened by lyrical passages, by the use of choruses and spectacular settings, and by the turn from classical subjects, for example, *Bérénice* (1670) and *Phèdre* (1677), to Biblical subjects in *Esther* (1689) and *Athalie* (1691). In all his dramas women are the chief protagonists and the dra-



Members of a 17th-century literary salon listen to a reading of Molière's works.

matic tensions derive chiefly from the vicissitudes of love.

Molière (pen name of Jean Baptiste Poquelin), third of the famous 17th-century playwrights, is the French master of comedy. His fine sense of theater, which makes his work playable even to modern audiences, may be attributed, at least in part, to his having been an actor, perhaps one of the greatest comic actors of all times, and a director. Among his best-known comedies are *Les Précieuses Ridicules*, *Le Tartuffe* (1664), *Le Misanthrope* (1666), and *Le Bourgeois Gentilhomme* ("The Would-Be Gentleman", 1670). Molière satirized contemporary foibles, such as the affectations of the literary salons, and common human failings such as hypocrisy, gullibility, avarice, and hypochondria. Philosophically, he was akin to Rabelais and Montaigne in maintaining the right of the individual to develop according to his own inclination. See DRAMA: *National Drama: France*.

Notable contributions were made in this period by the Jansenists, a puritanical Catholic sect opposed to the Jesuits; see JANSEN, CORNELIS. Some of the most forceful and original French writers and thinkers of the age were Jansenists, among them the theological polemicists An-

toine Arnauld and Pierre Nicole (1625?-95) and above all the philosopher, physicist, mathematician, and mystic Blaise Pascal. In the *Pensées* ("Thoughts", 1670) Pascal sought to confute skepticism by the use of skepticism and concluded that there were spiritual realities beyond the range of human reason.

Among other notable writers of the period were the two moralists François de la Rochefoucauld and Jean de la Bruyère. La Rochefoucauld is regarded as one of the most brilliant epigrammatists of all time. In his *Réflexions ou Sentences et Maximes Morales* ("Reflections or Moral Thoughts and Maxims", 1665), he combines psychological insight with a concision that gives each of his epigrams a gemlike finish and compactness. His social standing as an aristocrat lent authority to his judgment of court life. Because the essence of his maxims is the vanity of human pretension and striving, he was enlisted as an ally by the puritanical Jansenists.

The moral judgment that Bruyère made upon his time was harsher and more comprehensive than La Rochefoucauld's. His major work, *Les "Caractères" de Théophraste, Traduits du Grec, avec les Caractères ou les Mœurs de ce Siècle* ("The 'Characters' of Theophrastus, Translated from the Greek, with Characters or Customs of This Century", 1688), is a collection of

epigrams interspersed with character studies portraying and satirizing personalities who embodied the vices and frailties of the time.

The best novelist of the period was Comtesse Marie Madeleine de La Fayette. Because it shows such psychological insight, her *La Princesse de Clèves* (1678) is valued as an early example of the modern novel. Written with charming art, it is distinguished for its economy, having two characters only, the lovers whose relationship takes up the entire action.

Jean de la Fontaine, who must be ranked with Racine as a poet and with the great moralists, is one of the great masters of the age. In his *Fables* (1668–92) he used the framework of the moral fable of Aesop. He brought to each fable, however, the ease and narrative interest of the short story. The use of animals as characters in an age of censorship enabled him to give free reign to his wit, his fancy, his humor, and his observation of human weaknesses.

The Age of the Enlightenment. Decline of French power had begun even before the end of the reign of King Louis XIV. The intellectual energies of the nation gradually turned toward change and reform. Because much of the intellectual effort went into dissipating the obscurantism of the Church and other institutional doctrine, the 18th century has been called the Age of Enlightenment (q.v.). Among its precursors were François de Selignac de la Mothe-Fénelon, Bernard Le Bovier de Fontenelle, and Pierre Bayle. In his *Histoire des Oracles* ("History of the Oracles", 1686) Fontenelle attacked the miraculous basis of Christianity and the Church under the pretext of exposing the credulity of the Greeks and the Romans. Fénelon's *Télémaque* (1699), advocated religious tolerance and was written as guide to his royal pupil, the Duc de Bourgogne (1682–1712). Both writers were distinguished for the charm of their style.

Bayle's *Pensées Diverses sur la Comète de 1680* ("Diverse Thoughts on the Comet of 1680", 1682) and, in particular, his *Dictionnaire Historique et Critique* ("Historical and Critical Dictionary", 1697) served the writers and thinkers who followed him as an intellectual armory. Imbedded in this mass of learning was an uncompromising religious skepticism supported by argument and examples.

The incarnation of the spirit of the Enlightenment was Voltaire. In his *Lettres Anglaises ou Philosophiques* ("English or Philosophical Letters", 1734) he attacked the methods by which, in his view, the Church exploited human weakness. He attacked also the theistic and optimistic systems of philosophers, theologians,

and reformists, particularly those of the German philosopher Gottfried Wilhelm von Leibniz and the British philanthropist Anthony Ashley Cooper, 7th Earl of Shaftsbury. In his own day Voltaire was regarded primarily as a philosopher, and his philosophic works overshadowed, until a later day, his satirical classics, such as the novel *Candide* (1759).

The empiricism of Sir Francis Bacon and John Locke, in England, had its French disciples, principally Étienne Bonnot de Condillac. Calling themselves "le parti des philosophes", the French rationalists rejected scholasticism and expounded the new mechanistic concepts. The latter were embodied also in the *Encyclopédie*, a work designed to comprehend and systematize all human knowledge; see *ENCYCLOPEDIA*. This vast undertaking was directed by Denis Diderot, whose witty *Le Neveu de Rameau* ("Rameau's Nephew") and other works entitle him to separate distinction as a creative writer. On the *Encyclopédie* he had the collaboration of many distinguished contemporaries, including naturalists, ethnologists, philosophers, economists, and statesmen.

A notable book of this period, *L'Esprit des Lois* (1748; Eng. trans., *The Spirit of Laws*, 1750) by Charles de Secondat, Baron de Montesquieu, remains an important influence upon the whole of modern political thought.

Eighteenth-century fiction, when it was not philosophical fantasy, like Voltaire's, was written in the spirit of *La Princesse de Clèves*. Like

Voltaire

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that novel, *Manon Lescaut* (1731) by Antoine François Prévost d'Exiles and *La Vie de Marianne* ("The Life of Marianne", 1731–41) by Pierre Carlet de Chamblain de Marivaux were limited to two characters and the crises of their love. More elaborate was the witty, scandalous novel of society intrigue, *Les Liaisons Dangereuses* (1782; Eng. trans., *Dangerous Connections*, 1784), by Pierre Ambroise François Choderlos de Laclos (1741–1803).

The naturalist Georges Louis Leclerc de Buffon devoted his life to the compilation of the monumental *Histoire Naturelle* ("Natural History", 44 vol., 1749–1804), a part of the vast reclassification of flora and fauna that preoccupied the 18th-century naturalists.

Although Jean Jacques Rousseau is now remembered mostly for his *Confessions* (1782; Eng. trans., 1783, 1790), he had a revolutionary effect on political thinking in his own time through his *Le Contrat Social* (1762; Eng. trans., *The Social Contract*, 1797), in which the relations of the individual to society are conceived as a contract whereby the individual surrenders some of his independent rights in return for equality of status and mutual assistance. The leaders of the French Revolution (q.v.) regarded themselves as his disciples. He had a revolutionary influence also on educational thinking, through his *Émile* (1762; Eng. trans., 1763), and on fiction, in which he may be said to have inaugurated the Romantic trend with his *Julie, ou la Nouvelle Héloïse* (1760; Eng. trans., *Julie, or the New Eloise*, 1773).

Finally, the work of André Marie de Chénier, who was guillotined at the age of thirty-one, deserves mention. Although he completed an amazing number of remarkable poems, he was, like the British poet John Keats, only at the beginning of his mature powers when he died. Like Keats, too, his poetry is distinguished for its pure beauty. Chénier is regarded by some authorities as the greatest French poet of the 18th century.

In the period of reaction that followed the French Revolution, the principal creative writers were Comte Joseph Marie de Maistre (1754–1821), who dwelt nostalgically on the glories of the *ancien régime*, and Vicomte François René de Chateaubriand, who promoted a revival of religion. However, in his Byronic individualism and in his dithyrambic celebration of nature, and even in his emphasis on the esthetic values of religion, Chateaubriand helped to usher in the Romantic movement in French literature.

The Romantic Movement. Anne Louise Germaine, Baronne de Staël-Holstein, better known

as Madame de Staël, despite her radical politics, anticipated in her novels the preoccupations and the methods of the Romanticists of the following generation. Her *Corinne* (1807) is regarded as her masterpiece.

Chief of the early Romanticists was Alphonse de Lamartine, a sentimental writer and an accomplished craftsman. The Romantics, urged on by their first successes, ventured to break rules and to replace classical restraint with ebullient emotion. The most productive as well as the most militant member of the Romantic movement was Victor Hugo, who, in *Hernani* (1830), used the stage as a forum from which to expound Romantic concepts. He was supported by the novelists Alexander Dumas père and Théophile Gautier, and the poets Alfred de Vigny, Alfred de Musset, and Charles Nodier (1780–1844). The writings of the Romantics influenced, and were influenced by, similar currents in painting and music, as in the works of the artist Eugène Delacroix and the composer Ambroise Thomas. See ROMANTICISM.

The conflict between revolutionary and reactionary thinking after the restoration of the French monarchy in 1815 was reflected in literature. The major writers of the conservative side have been cited in the foregoing. The radical writers included the poet Pierre-Jean de Béranger, twice imprisoned for Republican views expressed in his later verses; the novelist and early feminist George Sand, some of whose works were pioneer social novels; the historian Jules Michelet, who exalted the French Revolution; and the forerunners of socialism Claude Henri de Rouvroy, Comte de Saint-Simon, François Marie Charles Fourier, Pierre Joseph Proudhon, and Louis Blanc. A middle view appeared in the work of the historians François Pierre Guillaume Guizot, Louis Adolphe Thiers, and Augustin Thierry, and in the writing of Benjamin Constant de Rebecque. Constant's novel *Adolphe* (1816), however, for which he is chiefly known and in which he portrays his stormy love affair with Madame de Staël, has no political overtones.

The Realists. Honoré de Balzac may be said to bridge the Romantic movement and the realistic movement that followed it. In his vast force, variety, and comparative formlessness, he resembled the Romantic writers. Yet, in his materialistic cast of mind, his minute observation, and his preoccupation with factual detail, he may be classified as the first of the realists. His ambitious *La Comédie Humaine* (47 vol., 1829–50; Eng. trans., *The Human Comedy*, 40 vol., 1895–98), composed over a period of twenty years, consists of related novels and short stories. The

characters of this work include almost every class and every profession and reproduce, as no other work has done, the social scene of contemporary France. Other great French realists include Stendhal (pen name of Henri Beyle),



Honoré de Balzac

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Gustave Flaubert, and Prosper Mérimée. Stendhal's keen psychological perception, anticipating that of modern psychological novelists, was recognized and praised by Balzac. Stendhal's principal novels are *La Chartreuse de Parme* ("The Charterhouse of Parma", 1839) and *Le Rouge et le Noir* ("The Red and the Black", 1831). Flaubert's meticulous realism was best exemplified in his *Madame Bovary* (1857). His method is that of gradual accumulation, and its effects are subtle, for a growing sense of character and situation is constructed from a multitude of carefully observed details. Mérimée, in spite of certain Romantic qualities, may be included among the realists because of the psychological truth in his characterizations. His best works are lengthy short stories, among them *Carmen* (1846; Eng. trans., 1881), *Colomba* (1852; Eng. trans., 1853), *La Vénus d'Ille* ("The Venus of Ille", 1837), and *Mateo Falcone* (1876). The greatest French critic, Charles Augustin Sainte-Beuve, also may be included among the realists. He started as a partisan of the Romantics, but broke with them and became an advocate of realism. Believing that the critic's chief duty is not to judge but to understand, he ex-

plored biographical and environmental factors affecting an author's work. What have since been called sociological and psychological criticism virtually had their beginnings and perhaps their best examples in his writings. Among his chief works are *Causeries du Lundi* (15 vol., 1851-62; Eng. trans, *Monday Chats*, 1877); *Portraits des Femmes* ("Portraits of Women"); *Portraits Contemporains* ("Contemporary Portraits"); and *L'Histoire de Port-Royal* ("The History of Port-Royal", 1840-59).

Parnassians and Symbolists. In poetry, the reaction against Romanticism began with *Émaux et Camées* ("Enamels and Cameos", 1852; enlarged edition, 1872), by Théophile Gautier, who in his youth had been a leader of the Romantic school. It was carried further in the work of the group known as the Parnassians, outstanding among whom were Leconte de Lisle, Sully Prudhomme, and José Maria de Heredia. Unlike the Romantics, these poets sought and achieved a restrained, impersonal, and chiseled beauty, but their work may be regarded more as a return to classicism than as an advance from Romanticism. Different was the work of Charles Baudelaire. Although the technical polish of his verse is as marked as that of the Parnassians, he is intensely personal in his expression of his bitterness, agony, and despair. His great work is *Fleurs du mal* ("Flowers of Evil" 1857), the pub-

Charles Baudelaire



FRENCH LITERATURE

lication of which was suppressed until certain offending stanzas were removed.

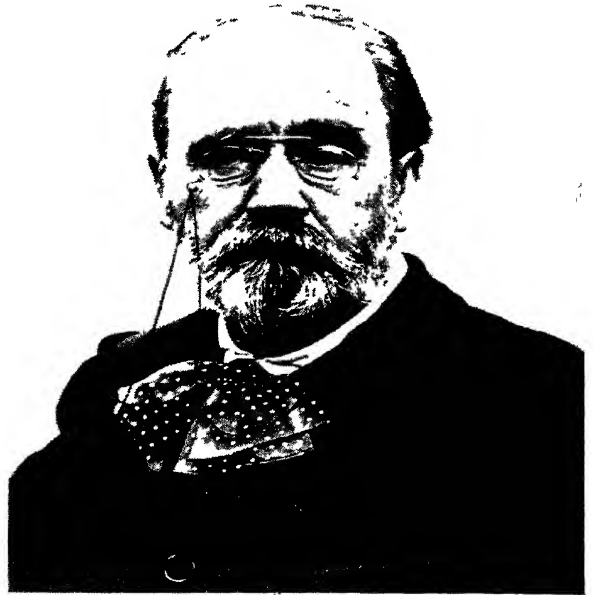
Baudelaire was followed by the symbolists, sometimes derogatorily termed the decadents, whom he influenced. Their work was marked by experimentation, notably in free verse. Among the symbolists were Paul Verlaine, Henri de Régnier (1864–1936), Stéphane Mallarmé, Isidore Lucien Ducasse, known as le Comte de Lautréamont (1846–70), Tristan Corbière (1845–75), Charles Cros (1842–82), Jules Laforgue (1860–87) and the American expatriate writers Francis Viélé-Griffin (1864–1937) and Stuart Merrill (1863–1915). Lautréamont's work *Les Chants de Maldoror* ("The Songs of Maldoror", 1868) subsequently influenced the surrealists. A number of Belgian writers were associated with the symbolists, among them Georges Rodenbach (1855–98), Émile Verhaeren, and Maurice Maeterlinck. The most influential of the symbolists was, however, Jean-Arthur Rimbaud, most of whose powerful and vivid poems were written before the age of nineteen. Symbolist poetry has a suggestive, veiled quality that links it to the impressionist paintings of artists such as Claude Monet and the works of impressionist composers such as Claude Debussy.

In prose, several writers sought symbolist effects. Among them were Remy de Gourmont and Édouard Dujardin (1861–1949), whose *Les Lauriers Sont Coupés* (1887) is an early example of so-called stream of consciousness writing, and Henri de Régnier, who was noted as a symbolist poet.

The Naturalists. During the late 19th century some of the realistic tendencies exemplified by the work of Flaubert led toward the movement known as naturalism, which stressed environment and heredity as the principal determinants of human action. The movement was given direction by the historian and critic Hippolyte Taine, whose best-known work is *Histoire de la Littérature Anglaise* (1864; Eng. trans., *History of English Literature*, 1871–72). Taine believed that human values such as virtue and vice are products like sugar and acids, and that human culture is the result of such formative influences as race and climate. The brothers Edmond and Jules de Goncourt were the precursors of naturalism in the novel, notably in *Germinie Lacerteux* (1864). After his brother's death, Edmond de Goncourt wrote several novels independently and influenced the work of Alphonse Daudet, a realist novelist whose work is lightened by humor in the manner of the British novelist Charles Dickens.

Naturalism was adopted as a fundamental

principle and literary method by Émile Zola, the most famous writer of the movement. He used the term particularly to describe the content and purpose of his novels, that were characterized by the type of historical determinism formulated by Taine. Zola's literary method is best seen in *L'Assommoir* ("The Grog Shop", 1877), *Nana* (1880) and *Germinal* (1885; Eng. trans., 1901). The influence of this method was so ex-



Émile Zola

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treme that in 1887 Edmond de Goncourt and Daudet, as well as five of Zola's own disciples, formed an opposition group responsible for a manifesto against Zola's novel *La Terre* ("Earth", 1888). Another counterforce is expressed in the work of Charles Joseph Paul Bourget (1852–1935), best known for his novel *Le Disciple* (1889). He stressed psychological rather than environmental motivation, an aspect of naturalism ignored by Zola. In the field of the short story, the most important naturalist writer is Guy de Maupassant, whose works include the collections *Mademoiselle Fifi* (1883) and *Contes des Jours et de la Nuit* ("Tales of the Days and the Night", 1885), as well as several novels; as a short-story writer, De Maupassant, whose literary master was Flaubert, has no peers.

Opposed to the materialism of the historian Taine and also to the Romantic individualism of Michelet is the work of the influential historian and critic Joseph Ernest Renan. His principal work is *Histoire des Origines du Christianisme* (8 vol., 1863–83; Eng. trans., *The History of the Origins of Christianity*, 5 vol., 1888–90), dealing

with the foundations of Christianity. Renan influenced the novelists Pierre Loti, Auguste Maurice Barrès, and Anatole France.

Anatole France, whose real name is Jacques Anatole Thibault, had social views somewhat akin to Zola's, but he used another medium, irony, for their expression. His books are an ironic commentary on the irrational forces of society. They are filled with pity for the weak and anger against the abuses of power. Most characteristic of his works, perhaps, are his realistic short novel, *Crainquebille* (1901), and his satirical fantasies *L'Île des Pingouins* (1908; Eng. trans., *Penguin Island*, 1909) and *La Révolte des Anges* (1914; Eng. trans., *The Revolt of the Angels*, 1914).

Another great 19th-century writer was the naturalist Jean Henri Fabre. His delightfully readable studies of insect life have become a model for popularized scientific writing abroad as well as in France.

20TH-CENTURY LITERATURE

Literature in 20th-century France was strongly affected by the ferment and change that marked the entire cultural life of the nation. To the impulses supplied by the symbolist innovations were added strong foreign impulses, such as the modern dance introduced by the American dancer Isadora Duncan and the modern ballet introduced by Russian ballet, the music of the Russian composer Igor Stravinsky, primitive art, and, in literature, the impact of the Russian novelist Fëdor Dostoevski and, a little later, of the Irish novelist James Joyce. The trends are interpenetrating and the changes so rapid that time will be necessary to set them in perspective.

Some Individualists. *Du Côté de chez Swann* (1913; Eng. trans., *Swann's Way*, 1928) by Marcel Proust, volume I of his *À la Recherche du Temps Perdu* (16 vol., 1913–27; Eng. trans., *Remembrance of Things Past*, 1922–32), is generally recognized as one of the greatest psychological novels of all time. Romain Rolland, whose most famous novel, *Jean Christophe*, appeared in ten volumes between 1905 and 1913, spent World War I in Switzerland, writing pacifist appeals to the combatants. His ideas on war were embodied in his novel *Clérambault: Histoire d'une Conscience Libre pendant la Guerre* ("Clérambault: History of a Free Conscience During the War", 1920). *L'Immoraliste* (1902; Eng. trans., *The Immoralist*, 1930) by André Gide expressed the conviction that, while freedom in itself is admirable, acceptance of the responsibilities demanded by that freedom is difficult, a theme which Gide carried further in *La Porte Étroite* (1909; Eng. trans., *Strait Is the Gate*, 1924). Gide's

work was distinguished by his independence of thought and expression. Roger Martin du Gard's first widely read novel, *Jean Barois* (1913; Eng. trans., 1949), is a study of the conflict between a mystical background and the scientific mind in the 1880's. Among outstanding Catholic writers were the mystical poet and novelist Francis Jammes (1868–1938) and François Mauriac. Mauriac's work, completely innocent of didacticism or proselytism, is devoted to the study of evil, sin, weakness, and suffering. His work shows the influence, not of the novelist, but of Pascal, Racine, and Baudelaire, in all of whom a sense of tragedy fosters a certain aloofness of attitude and starkness of style.

Jean Cocteau, active in many different fields, was the author, among other works, of the book of poems *Plain-Chant* (1923), the novel *Les Enfants Terribles* (1929; Eng. trans., *Children of the Game*, 1955), the play *La Machine Infernale* (1934; Eng. trans., *The Infernal Machine*, 1936), the film *Le Sang d'un Poète* (1930; U.S. release, *Blood of a Poet*, 1933), criticism, and ballets. Although he was elected one of the so-called immortals of the French Academy, his creative position remains controversial.

Jean Giraudoux first won attention by his realistic accounts of French provincial life (*Les Provinciales*, 1909). The impression he then made as a forceful and original writer was strengthened by the realism of his war books, one of which was awarded the Grand Prix Balzac. Later he established a comparable position as a dramatist, two of his plays, *Amphitryon 38* (1929; Eng. trans., 1938) and *La Folle de Chaillot* (1945; Eng. trans. *The Madwoman of Chaillot*, 1947), having achieved international success. Most of Giraudoux's work exhibits inventive fantasy and graces of style that some critics have condemned as preciosity, although others have acclaimed him one of the great stylists of literature.

After writing first for the theater, Jules Romains turned to the novel. In *Les Hommes de Bonne Volonté* (27 vol., 1932–46; Eng. trans., *Men of Good Will*, 1933–46) he attempted to compress the whole of modern French life into a work of twenty-seven volumes. The conception of the work draws upon the doctrine of unanimism, that is, that the individual and the society in which he lives are one. Jules Romains's novel portrays the collective soul of a society.

Guillaume Apollinaire was a poet and writer of cultural manifestos. His *Les Peintres Cubistes* (1913; Eng. trans., *The Cubist Painters*, 1949) was instrumental in establishing the cubist school of painting; see CUBISM. His volumes of poems *Al-*



Madame Sidonie Gabrielle Claudine Colette, pictured with other members of the Goncourt Academy in 1945
French Embassy Press & Information Div

cools ("Spirits", 1913) and *Calligrammes* (1918) were popular among the young surrealists (see below), upon whom he had much influence. The Catholic poet, playwright, and apologist Paul Claudel remained outside of all literary coteries. His religious feeling dominates his work and is the inspiration of his poetry, *Cinq Grandes Odes* (1910; Eng. trans., *Five Great Odes*, 1967) and *La Cantate à Trois Voix* ("The Cantata in Three Voices", 1931); plays, *Le Livre de Christophe Colomb* ("The Book of Christopher Columbus", 1930); and essays, *Figures et Paraboles* (1936). He created a dramatic form unique in French literature, although it has affinities with the drama both of William Shakespeare and the Spanish dramatist Lope de Vega. Beginning as a Symbolist Paul Valéry became one of the greatest philosophical poets of the time. Intent upon technique, he strove to express his abstract and mathematical ideas within the strictest formal framework. Mallarmé and Valéry continued a tendency in modern French poetry introduced by Baudelaire, through his translations of works by the American writer Edgar Allan Poe, and his own subsequent work. It is characterized, in part, by a special concern with significant sound. In his definition of symbolism, Valéry observes that the new poetry seeks to recapture from music what belongs to poetry. But in practice Valéry revived the classical rules of prosody. He believed that the act of writing poetry is a bending of the will to useful constraints.

The Théâtre du Vieux-Colombier, founded in 1913 by Jacques Copeau, did much to encourage young playwrights. It produced, during its first season, plays by Claudel and Martin du Gard, among others.

The favorite themes in the novels of Henri de Montherlant (1896–1972) are sports, *Les Olympiques* (1924); bullfighting, *Les Bestiaires* (1926; Eng. trans., *The Bullfighters*, 1927); and the place of woman in modern life, *Les Jeunes Filles*, (4 vol., 1935–40; Eng. trans., *Young Girls*, 2 vol., 1937–40). Like Mauriac, Giraudoux, and other novelists, Montherlant turned to the theater. His historical plays, such as *La Reine Morte* ("The Queen Dies", 1942), resemble in part the blood tragedies of the Elizabethan theater; see **DRAMA: British**. To these plays he has added a few dramas in modern dress and setting and with classically sober and strong texts. His work is marked by elegance of style but at the same time by vigor and clarity.

Because of her great popular success and her extraordinary fecundity (her published works total more than eighty volumes), Sidonie Gabrielle Colette, popularly known as Colette, was slow to win recognition as a serious writer. The literary value of her writing was early recognized in France by Marcel Proust and André Gide and by Somerset Maugham in England and by Glenway Wescott (1901–) in America, who regarded her as the greatest French writer of her time. Her style has effortless grace, and her keen perceptions link her with the great psychological realists of world literature.

World War I. The realistic account of World War I in *Le Feu* (1916; Eng. trans., *Under Fire*, 1917) by Henri Barbusse inspired *Les Croix de Bois* (1919; Eng. trans., *Wooden Crosses*, 1921) by Roland Dorgelès (1886–1973), forerunners of the antiwar books of the late 1920's that appeared not only in France but also in Germany, England, and the United States. The essayist André Maurois found war a subject for humor in his *Les Silences du Colonel Bramble* (1918; Eng. trans., *The Silence of Colonel Bramble*, 1920). Later he became one of the initiators of

the so-called novelized biography in his *Ariel, ou la Vie de Shelley* (1923; Eng. trans., *Ariel, The Life of Shelley*, 1924). The gentle irony with which the surgeon Georges Duhamel treated war in his *Vie des Martyrs* (1917; Eng. trans., *The New Book of Martyrs*, 1918) sets him apart both from those who looked upon war as a glorious experience and from others who found horror in everything connected with war. In his later novels Duhamel became a chronicler of bourgeois France. The full horrors of World War I found their expression in *Le Grand Troupeau* ("The Great Herd", 1931) by Jean Giono, all of whose works express militant pacifism and antipathy to the machine age.

The Surrealists. The later years of World War I were notable for the growth (in France, Germany, Switzerland, and America) of the movement of young poets and painters known as Dadaism. In revolt against all traditional and artistic forms, they set out with the declared intention of destroying art. About 1923, certain members of the group, under the leadership of André Breton, broke away and formed a new movement which, using a word invented by Guillaume Apollinaire, they called surrealism. Breton, who was the leader and the expositor of the movement, began his career as a medical student. In 1916 he fell under the influence of Jacques Vaché, whose proclaimed desire was to live in a continual state of mental aberration. The impression made by this almost legendary character, together with Breton's enthusiasm for the poems of Rimbaud, produced a philosophy of art and life in which the most important values were those dictated by the subconscious. Despite the attacks which were leveled at the movement, it had its sources deep in the literature of France. Lautréamont, Baudelaire, Cros, Rimbaud, and the Symbolists in general were its direct ancestors.

Because of Breton's dictatorial nature, which was matched by the independence of its other members, the group always had a shifting membership. Some of those who have, at one time or another, been important surrealists are mentioned below.

Beginning as a dadaist, Louis Aragon became a surrealist in 1924, and produced several books of poems, including *Le Libertinage* ("Libertinism", 1924). In 1928, however, in *Traité du Style* ("Treatise of Style"), he attacked the motives behind their works. Becoming a Communist in 1930, he was expelled from the surrealist movement. His novels *Les Cloches de Bâle* (1934; Eng. trans., *The Bells of Basel*, 1936) and *Les Beaux Quartiers* (1936; Eng. trans., *Residential Quarter*,

1938) brought him acclaim at home and abroad. During the German occupation of France during World War II, he once more turned to poetry, in *Le Crève-Coeur* (1941; Eng. trans., *Heartbreak*, 1943) and *Les Yeux d'Elsa* (1942; Eng. trans., *The Eyes of Elsa*, 1944), to lament the defeat of his country.

In Paul Éluard (1895–1952) the movement found, perhaps, its greatest poet. After a dadaist start, his poems, in *La Nécessité de la Vie et la Conséquence des Rêves* ("The Necessity of Life and the Consequences of Dreams", 1921), were patterns of images viewed in detachment. With his adherence to the surrealist movement, in about 1923, Éluard wove his images into a contemplation of love as a part of the universal spirit, particularly in *Mourir de ne pas Mourir* ("To Die of Not Dying", 1924), *Capitale de la Douleur* ("Sorrow's Capital", 1926), *L'Amour de la Poésie* ("The Love of Poetry", 1929), *La Vie Immédiate* ("Life Immediate", 1932), *La Rose Publique* ("The Public Rose", 1934), and *Les Yeux Fertiles* ("The Fertile Eyes", 1936); in these books the images exist as the pure emanation of the poet himself, and have no connection with nature as a separate entity. Although no longer closely connected with the surrealists, Éluard's poems of World War II, *Poésie et Vérité* ("Poetry and Truth", 1942) and *Au Rendezvous Allemand* ("At the German Rendezvous", 1945), employ the same technique of imagery to lament the fall of France and extol its subsequent resistance.

Philippe Soupault (1897–), founder of the surrealist movement with Breton, was disowned in 1930 for his failure to adhere to its principles in his studies *Henri Rousseau, le Douanier* (1927) and *William Blake* (1928; Eng. trans., 1928). Since then his important books have been *Charlot* (1931), an examination of the American comedian Charles Chaplin, and *Souvenirs de James Joyce* ("Remembrances of James Joyce", 1944), in which Soupault recalls his experiences as one of the translators of Joyce's novel *Ulysses*.

The Spirit of the 20th Century. Certain novelists strove in a different, nonsurrealist way to express the spirit of the times. André Malraux, having lived in the presence of revolution and counterrevolution, mirrors a life always in the shadow of death in his novels *La Condition Humaine* (1933; Eng. trans., *Man's Fate*, 1934), dealing with the revolution in China; *Les Temps du Mépris* (1935; Eng. trans., *Days of Wrath*, 1936), dealing with the anti-Nazi underground in Germany; and *L'Espoir* (1938; Eng. trans., *Man's Hope*, 1938), dealing with the Spanish Civil War



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UPI



PARIS MATCH

René Saint-Paul



Top, left: Jean-Paul Sartre, founder of the existentialist movement, poses with his friend and literary colleague Simone de Beauvoir. Top, right: Albert Camus. Right, center: Louis-Ferdinand Céline. Above: Jean-Jacques Servan-Schreiber. Right: Françoise Sagan.



of 1936 to 1939. The American émigré novelist Julian Green, who writes in French, depicts a strange hallucinatory world in which an atmosphere of terror is unrelieved by humor. He treats French provincial life in such novels as *Adrienne Mésurat* (1927; Eng. trans., *The Closed Garden* 1928) and *Léviathan* (1929; Eng. trans., *The Dark Journey*, 1929) and American life in *Mont Cinère* (1926; Eng. trans., *Avarice House*, 1927) and *Moira* (1950; Eng. trans., 1951). Green's first play, *Sud* ("South", performed in Paris in 1953), is a classical tragedy.

The aviator Antoine de Saint-Exupéry became known as the greatest writer of his generation on man's conquest of the air; his works include *Courrier Sud* (1929; Eng. trans., *Southern Mail*, 1933), *Vol de Nuit* (1931; Eng. trans., *Night Flight*, 1932), *Terre des Hommes* (1939; Eng. trans., *Wind, Sand, and Stars*, 1939), *Pilote de Guerre* (1942; Eng. trans., *Flight to Arras*, 1942), and *Le Petit Prince* (1943; Eng. trans., *The Little Prince*, 1943). For sheer misanthropy the novels of Louis-Ferdinand Céline have seldom been surpassed; in *Voyage au Bout de la Nuit* (1932; Eng. trans., *Journey to the End of Night*, 1934) there is catastrophe without hope of relief, and in *Mort à Crédit* (1936; Eng. trans., *Death on the Installment Plan*, 1938) all human aspirations are subjected to contemptuous irony.

Among the most distinguished poets of this century is (Marie-René Auguste) Alexis Saint-Léger Léger (pen name Saint-John Perse). His *Anabase* (1924; Eng. trans., 1930) represents the poet in his literary conquests as a conqueror of foreign lands with arms and horses. Saint-John Perse pictures the poet paradoxically as both detached from human activity and deeply involved in it. The official attitude of the symbolists was aloofness, that of the surrealists was aggressiveness. Saint-John Perse represents a more balanced, almost classic, attitude in which the poet both contemplates life and participates in it. This attitude is apparent in *Amers* (1957; Eng. trans., *Seamarks*, 1958), his longest poem. He was awarded the Nobel Prize in literature in 1960.

René Char (1907–) is one of the outstanding poets of his generation. His initiation during the 1930's into the practices and theories of surrealist art was followed in the early 1940's by his participation in the Resistance movement as a captain of the Maquis, a guerrilla group, in Provence. His best poems, written between 1940 and 1944 and collected in *Feuillets d'Hypnos* ("Leaves of Hypnosis"), are primarily the communication of something ineffable, not merely war poems. For Char, the ineffable is the secret

source of all poems. Among the writers published after World War II was Françoise Sagan whose first novel, *Bonjour Tristesse* (1954), was awarded the Prix des Critiques, and the journalist and political figure Jean-Jacques Servan-Schreiber, who wrote *Le Défi Américain* (1968; Eng. trans., *The American Challenge*, 1968).

Existentialism. In the 1940's, under the leadership of the philosopher, dramatist, and novelist Jean-Paul Sartre, the negative philosophical and literary movement called existentialism took form. The general philosophy is outlined in Sartre's *L'Être et le Néant* (1943; Eng. trans., *Being and Nothingness*, 1953), and derives from Søren Kierkegaard by way of the German philosophers Edmund Husserl (1859–1938) and Martin Heidegger. The thesis of existentialism is essentially that human existence is pointless and a frustration, and that man is in fact only the sum of his experiences. In his plays *Les Mouches* (1943; Eng. trans., *The Flies*, 1946), *Huis-Clos* (1944; Eng. trans., *No Exit*, 1946), and *Les Mains Sales* (1948; Eng. trans., *Dirty Hands*, 1949), Sartre expanded the problems already raised before the war in his book of short stories *Le Mur* ("The Wall", 1939). In his trilogy *Les Chemins de la Liberté* ("The Roads of Liberty", 1945–49) he attempted to show man as being without illusions and aware of his necessity to participate in all the functions of society. Sartre's most zealous disciple was Simone de Beauvoir (1908–), who wrote, among many works, the novels *L'Invitée* ("The Invited", 1943), *Le Sang des Autres* (1946; Eng. trans., *The Blood of Others*, 1948), and *Les Mandarins* (1955; Eng. trans., 1956), the last named of which, in a thinly disguised form, deals with the private relationships of some of the leading French existentialists. At one time Albert Camus might have been described as an existentialist, particularly in his play *Caligula* (1944; Eng. trans., 1948); however, in both his important novels, *L'Étranger* (1942; Eng. trans., *The Stranger*, 1946) and *La Peste* (1947; Eng. trans., *The Plague*, 1948), he recognized the desirability, and indeed the necessity, of human endeavor. In 1957 Camus was awarded the Nobel Prize in literature. He was killed in an automobile accident in 1960.

Recent Trends. During the 1950's, two schools of experimental writing flourished in France. The "theater of the absurd" or "anti-theater" is best illustrated in the plays of Rumanian-born Eugène Ionesco; Samuel Beckett, an Irishman who began writing in French after World War II; and Jean Genet. The popular *En Attendant Godot* ("Waiting for Godot", 1948) of Beckett, and *Les Nègres* (1959; Eng. trans., *The Blacks*,

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1960) and *Les Paravents* (1961; Eng. trans., *The Screens*, 1962) of Genet demonstrate this school of writing, which is opposed to the psychological analysis and the ideological content of existentialism.

Simultaneously with the "anti-theater", the "anti-novel" or *nouveau roman* has attracted considerable attention, chiefly through the novels and theories of Alain Robbe-Grillet (1922–), Nathalie Sarraute (1902–), and Michel Butor (1926–). As with the playwrights, the new novelists have opposed the traditional forms of the psychological novel and emphasize the purely objective world of things. Emotions and sentiments are not analyzed as such; rather, the reader has to imagine what they are as he follows the relationship between characters and the objects they touch and see. Two highly successful novels of this school, *La Modification* by Butor and *La Jalousie* (1957; Eng. trans., *Jealousy*, 1960) by Robbe-Grillet, appeared in 1957.

The decade of the 1960's is best characterized by the flourishing of a new school of literary criticism. Roland Barthes (1915–) is a leading exponent of this method of criticism, usually referred to as structuralism. He engaged in controversy with Raymond Picard (1917–), who represented the more traditional, academic criticism. The structuralist is concerned with the relationship between society and literature, and in order to expound his criticism often refers to the disciplines of anthropology, ethnology, and linguistics. The role of the literary critic is thus expanded to include discoveries and the knowledge of several cultural disciplines.

Biographical works flourished in the 1970's, particularly those by veteran writers. André Maurois published a reminiscence of General Charles de Gaulle, *Les Chênes qu'on abat* ("Felled Oaks", 1971); Jean-Paul Sartre brought out the first three volumes of his monumental work on Gustave Flaubert; and Simone de Beauvoir continued her autobiographical series with *Tout compte fait* ("All Things Considered", 1972). A major event was the publication of Volume I of the second set of Charles de Gaulle's own memoirs, called *Mémoires d'espoir* (1970; Eng. trans., *Charles de Gaulle: Memories of Hope*, 1972).

See separate articles on the principal movements and schools mentioned and on those individuals whose birth and death dates are not given.

W.F.

FRENCH MUSIC, in the broadest sense, vocal and instrumental music of the peoples who have lived within the boundaries of present-day France, especially since the late 9th century. In

this article the discussion of French music is confined to art music; see **MUSIC: Kinds of Music**.

500–1300. The first original French contribution to music was Gallican chant, a simple form of plainsong (q.v.), or melody sung in unison, used in Christian churches. In 800, however, Charlemagne (q.v.), Holy Roman Emperor, substituted the Roman rite from Italy for local forms of worship, and thereafter the more complex Gregorian chant (q.v.) prevailed; see also **LIT. URGY**.

Although Gregorian chant usually was sung without accompaniment, a second voice part, used on festive occasions in the larger European churches, was added at the beginning of the 12th century. This formed a two-part harmonic texture called organum (see **RELIGIOUS MUSIC**). At this time, true polyphony—the harmonic combining of two or more equal voice parts—was born when, at the Abbey of Saint Martial in southwest France, the shape and rhythm of added melodies began to grow independent of the basic chant. In the mid-12th century, at the Cathedral of Notre Dame in Paris, composers such as Leoninus (fl. 1160–80) and Perotinus (fl. 1180–1200) added two and three melodies to the basic chant; they thus contributed to the ultimate development in the following century of the sacred polyphonic composition called the motet (q.v.). Until the mid-14th century, most of Europe copied the sacred musical styles that originated in Paris.

So far as is known, secular music up to the 14th century consisted of songs written mainly by noblemen. In southern France the poet-composers of these songs, which were mostly concerned with the courtly ideal of love, were called troubadours, and in northern France, trouvères (qq.v.).

1300–1500. In the 14th century, French composers led the world in adopting a new and freer form of polyphonic composition known as *ars nova* (M.L., "new art"). The leading composer in this new style was Guillaume de Machaut (1304?–77).

Near the end of the 14th century, a simpler style developed among composers at the court of Burgundy (q.v.) in northwest France. These composers specialized in chansons, secular songs for three and four voice parts. Their motets, instead of being complex and therefore difficult to perform in the *ars nova* manner, featured graceful tunes. The Masses, however, became more elaborate; see **MASS**. Notable Burgundian composers were Guillaume Dufay (1400?–74) and Gilles Binchois (1400?–60).

1500–1600. French musical dominance in Europe, which had lasted for almost 400 years, ended in the 16th century, when leadership passed to the Netherlands and Italy. The most important music by such French composers of this period as Claudin de Sermisy (1490?–1562) and Clément Janequin (1485?–1560?) was in the form of descriptive songs for several voice parts. French composers also provided unaccompanied tunes for Huguenots (French Protestants) to sing to rhymed versions of the psalms. Loys Bourgeois (1510?–61?), who wrote many psalm tunes, used less vigorous rhythms and melodies than did contemporary composers of similar music in Germany (see CHORALE). Psalm settings for four and more voice parts were composed by Claude Goudimel (1505?–72).

1600–1750. During the 17th and early 18th centuries, the court provided a setting for much French musical activity. Here the ballet and aristocratic dances were part of elaborate stage spectacles in which the king and his courtiers were performers; see BALLET; DANCE. Beginning about 1652, the Italian-born French composer Jean Baptiste Lully wrote many ballets and, later, operas for the court of Louis XIV (q.v.). Gradually Lully created a French operatic style by combining traditional court spectacle with plots of contemporary French dramas by such playwrights as Molière, set to musical forms from ballet, dance, and Italian opera; see OPERA. Lully's operas, with their distinctive forms of overture and recitative (qq.v.), were imitated by French composers until about 1730, when Jean Philippe Rameau (q.v.) began introducing harmonic and dramatic innovations in his operas.

During this period, French composers also wrote many instrumental pieces, chiefly for the lute and the harpsichord (qq.v.). Denis Gaultier (1603?–72), a famous lutenist, composed many partitas, or suites of dance pieces (see SUITE), for his instrument. Similar pieces for the harpsichord were written by Jacques Champion de Chambonnières (1602?–72) and Louis Couperin (q.v.).

About 1720, a new style, known as the *style galant*, or courtly style, developed in France. Its emphasis was on the entertaining and decorative aspects of music. The playfulness found in the harpsichord suites of François Couperin, which bear such titles as "Little Windmills" and "Mysterious Barricades", is characteristic of the courtly style. At the end of this period, the French school of violin playing became preeminent, mainly through the work of the violinist and composer of operas and concerti grossi Jean-Marie Leclair (1697–1764).

Opera. During the late 18th and early 19th centuries, many foreign-born composers began to move to Paris, where music, especially opera, was in great demand. The German composer Christoph Willibald Gluck produced many of his operas in Paris in the 1770's. He emphasized dramatic values rather than vocal display and added much choral and orchestral music to the traditional solo arias. From the works of Gluck and his followers, particularly the Italian-born Luigi Cherubini, evolved the French grand opera style, which reached its ultimate realization in the 1830's in the operas of the German-born composer Giacomo Meyerbeer. A lighter operatic style, called *opéra comique*, or comic opera (q.v.), began to develop concurrently at the end of the 18th century. This form utilized less serious subjects and included spoken dialogue as well as singing. One of the originators of the comic opera was the Belgian-born composer André Ernest Modeste Grétry. Fifty years after his death in 1813, the form reached its zenith in the French operettas of the German-born composer Jacques Offenbach; see OPERETTA. Eventually, French composers effected a merger of the two operatic styles, producing several characteristic 19th-century French operas that are still popular, such as *Faust* (1859) by Charles François Gounod, *Carmen* (1875) by Alexandre César Léopold Bizet, known as Georges Bizet, and *Manon* (1884) by Jules Émile Massenet.

Personalism. Some 19th-century French composers were influenced by those contemporary German composers who felt that music should be a vehicle for ingenuity and personal expression. The leading representative of this Romantic concept in France was Louis Hector Berlioz, who was followed by the Belgian-born César Auguste Franck, his pupil Paul Marie Théodore Vincent d'Indy, and others. Such French composers as Charles Camille Saint-Saëns and his pupil Gabriel Urbain Fauré belonged to a school that believed music should consist primarily of attractive designs in sound.

Late in the 19th century, France became a world leader musically for the first time since the 16th century, chiefly through the music of a great innovator, Achille Claude Debussy. He perfected the French art song and brought to his symphonic, instrumental, and operatic compositions a distinctive style that was called impressionistic; see IMPRESSIONISM (in music). Composers throughout the 20th century have found inspiration in impressionism.

Neoclassicism. Maurice Joseph Ravel, although he composed some music in the impressionistic style, generally preferred more distinct

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formal outlines and melodic shapes. In this he anticipated the neoclassic, or renewed classic, style that developed in Paris after World War I; see CLASSICISM. Among the French neoclassic composers were Erik Satie and a group of his followers known as *les Six* ("the Six"), whose best-known members were Darius Milhaud, Francis Poulenc, and Arthur Honegger; see SIX, LES. The Russian-born Igor Stravinsky, the most famous of neoclassic composers, lived and worked in Paris in the 1920's and 1930's. Another influential figure, Nadia Boulanger, was the teacher of composers from all over the world. **After World War II.** The most important French composers since the 1940's have been Olivier Messiaen and Pierre Boulez. Both replaced traditional ideas of melody and form with complex, numerically derived structures and with an emphasis on layers of sound that overlap or follow one another in various ways. Their approach has been widely copied since the 1950's. A form of electronic music (q.v.), called *musique concrète* (Fr., "concrete music"), which also has been widely copied, creates new sounds, chiefly by distorting normal tones through the use of electronic devices. The form was developed in the late 1940's by several composers working in Paris. See MUSIC: History. See also separate articles on those individuals whose birth and death dates are not given.

FRENCH REVOLUTION, cataclysmic political and social upheaval, extending from 1789 to 1799, which resulted, among other things, in the overthrow of the Bourbon monarchy in France (see BOURBON: *French Bourbons*) and in the establishment of the First Republic. It was generated by a vast complex of causes, chief among which were the corrupt and authoritarian character of the ancien régime, extortionate taxation of the peasantry, impoverishment of the workers, the intellectual ferment of the Age of Enlightenment (see ENLIGHTENMENT, AGE OF; ROUSSEAU, JEAN JACQUES; DIDEROT, DENIS), the example of the American Revolution (q.v.), and the determination of the bourgeoisie (q.v.) to supplant the nobility and the clergy as custodians of political power. The revolution itself produced a similarly vast complex of consequences. Detailed examination of these causes and consequences is impossible within the scope of this article, which deals chiefly with the highlights of the revolutionary period. For an account of many of the important events that preceded and followed the revolution, see EUROPE: History, Modern; FRANCE: History.

Historical Reasons for the Revolution. For more than a century before the accession of

Louis XVI in 1774, the French government had undergone periodic economic crises, resulting from the long wars waged during the reign of Louis XIV, royal mismanagement of national affairs under Louis XV, the losses incurred in the French and Indian War (1756–63), and increased indebtedness arising from loans to the American colonies during the American Revolution (1775–83). The advocates of fiscal, social, and governmental reform became increasingly vocal during the reign of Louis XVI. In August, 1774, Louis appointed a liberal comptroller general, the economist Anne Robert Jacques Turgot, Baron de l'Aulne, who instituted a policy of strict economy in government expenditures. Within two years, however, his dismissal was forced by reactionary members of the nobility and clergy, supported by Queen Marie Antoinette, and most of the reforms were withdrawn. Turgot's successor, the financier and statesman Jacques Necker, similarly accomplished little before his downfall in 1781, also because of the opposition of the reactionaries, but he won popular acclaim by publishing an accounting of the royal finances, which revealed the heavy cost of privileges and favoritism. During the next few years the financial crisis became steadily more acute. Popular demand for convocation of the States-General (an assembly comprised of representatives of the clergy, the nobility, and the people), which had been in adjournment since 1614, finally compelled Louis XVI in 1788 to authorize national elections. During the ensuing campaign, censorship was suspended, and a flood of pamphlets expressing ideas derived from the Enlightenment circulated throughout France. Necker who was reinstated as comptroller general by Louis in 1788, supported the king in his decision that the third estate (commoners) would have as many representatives in the States-General as the first estate (the clergy) and the second estate (the nobility) combined, but both he and Louis failed to make a ruling on the method of voting.

Despite general agreement among the three estates that national salvation required fundamental changes in the status quo, class antagonisms precluded unity of action in the States-General, which convened at Versailles on May 5, 1789. The delegations representing the privileged strata of French society immediately challenged the third-estate caucus by rejecting its procedural proposals on methods of voting. The proposals were designed to establish a system of simple majority rule, thereby insuring domination of the States-General by the third estate, numerically the most powerful caucus. The

deadlock on procedure persisted for six weeks, but finally, on June 17, the insurgent caucus, led by Emmanuel Joseph Sieyès and Honoré Gabriel Riqueti, Comte de Mirabeau, proclaimed itself the National Assembly. This display of defiance of the royal government, which had given its support to the clergy and nobility, was followed by the passage of a measure vesting the National Assembly with sole power to legislate taxation. In swift retaliation, Louis deprived the National Assembly of its meeting hall. The National Assembly responded, on June 20, by gathering at a Versailles tennis court and swearing, in what is known in history as the Tennis Court Oath, that it would not dissolve until it had drafted a constitution for France. At this juncture, serious divisions split the ranks of the upper two estates and numerous representatives of the lower clergy and a number of liberal nobles broke off to join in forces with the National Assembly.

Open Rebellion. Continued defiance of royal decrees and the mutinous mood of the royal army forced the king to capitulate. On June 27 he ordered the refractory nobility and clergy to join the unicameral legislature, which then designated itself the National Constituent Assembly. Yielding, however, to pressure from the queen and the Comte d'Artois, later Charles X, Louis issued orders for the concentration of several loyal foreign regiments in Paris and Versailles. At the same time, Necker, the popular apostle of a regenerated France, was again dismissed from the government. The people of Paris replied to these provocative acts with open insurrection. Rioting began on July 12, and on July 14 the Bastille (q.v.), a royal prison that symbolized the despotism of the Bourbons, was stormed and captured. Immediately following the Parisian outburst, violence, sporadic local disturbances, and peasant uprisings against oppressive nobles occurred in many parts of France, alarming the propertied bourgeoisie no less than the royalists. Panic-stricken over these ominous events, the Comte d'Artois and other prominent reactionaries, the first of the so-called émigrés (q.v.), fled the country. The Parisian bourgeoisie, fearful that the lower classes of the city would take further advantage of the collapse of the old administrative machine and resort again to direct action, hastily established a provisional local government, and organized a people's militia, officially designated the National Guard. A red, white, and blue tricolor was substituted for the white standard of the Bourbons as the national flag. Provisional local governments and militia units were soon estab-

lished throughout the nation. The National Guard was placed under the command of the Marquis de Lafayette, a hero of the American Revolution. Unable to stem the rising tide of revolt, Louis XVI withdrew his loyal troops, recalled Necker, and formally legalized the measures taken by the provisional authorities.

Drafting a Constitution. Provincial unrest and disorder, known as the Great Fear, stimulated the National Constituent Assembly to action. During the night session of Aug. 4, 1789, the clergy, nobles, and bourgeoisie renounced their privileges, a few days later the assembly passed a law abolishing feudal and manorial prerogatives, but guaranteeing compensation in certain cases. Parallel legislation included prohibition of the sale of public offices, of exemption from taxation, and of the right of the Roman Catholic Church to levy tithes. The assembly then proceeded to grapple with its primary task, the drafting of a constitution. In the constitutional preamble, known in history as the Declaration of the Rights of Man and of the Citizen (q.v.), the delegates formulated the Revolutionary ideals later summarized as *Liberté, Égalité, Fraternité* (Liberty, Equality, Fraternity). While the Constituent Assembly deliberated, the hungry population of Paris, a hotbed of discontent and of rumors of royalist conspiracy, clamored for food and agitated for action. Reports of a gala banquet at Versailles stirred the political ferment in Paris to the boiling point. On October 5-6 a large body of Parisians, mostly women, marched on Versailles and laid siege to the royal palace. Louis and his family were rescued by Lafayette, who, on demand of the crowd, escorted them to Paris. After this episode some of the conservative members of the Constituent Assembly, which followed the king to Paris, handed in their resignations. In the capital city both the court and the assembly became increasingly subject to pressures from Parisian citizens. Radical sentiment became more and more pronounced in the subsequent deliberations of the assembly, but the original objective, a constitutional monarchy, was retained.

The first draft of the constitution received the approval of the French monarch on July 14, 1790, at elaborate ceremonies in Paris, attended by delegations from all parts of the nation. By the terms of the document, the provinces of France were abolished and the country was divided into departments, each named for a mountain or stream and provided with a local elective administrative apparatus. Hereditary titles were outlawed, trial by jury in criminal cases was ordained, and fundamental modifica-

shape. These changes were dictated, first of all, by the mood of suspicion and discontent among the disfranchised section of the population. Wanting the vote and relief from social and economic misery, the nonpropertied classes steadily gravitated toward radicalism. This process, largely accelerated throughout France by the highly organized Jacobins and, in Paris, by the Cordeliers (q.v.), acquired further impetus as reports circulated that Marie Antoinette was in constant communication with her brother Leopold II, Holy Roman Emperor. Like most of the other monarchs of Europe, Leopold had afforded sanctuary to the émigrés and had otherwise revealed his hostility to the revolutionary occurrences in France. Popular suspicions regarding the activities of the queen and the complicity of the king were confirmed when, on June 21, the royal family was apprehended at Varennes while attempting to escape from France.

The Growth of Radicalism in the Government. On July 17, 1791, the republicans of Paris massed in the Champ de Mars and demanded the deposition of the king. On the command of Lafayette, who was affiliated politically with the Feuillants (q.v.), a group of moderate monarchists, the National Guard opened fire on the demonstrators and dispersed them. The bloodshed immeasurably widened the cleavage between the republican and bourgeois sections of the population. After suspending Louis for a brief period, the moderate majority of the Constituent Assembly, fearful of the growing disorder, reinstated the king in the hope of stemming the mounting radicalism and of preventing foreign intervention. Louis took the oath to support the revised constitution on Sept. 14. Two weeks later, with the election of the new legislature authorized by the constitution, the Constituent Assembly dissolved. Meanwhile, on Aug. 27, Leopold II and Frederick William II, King of Prussia, had issued a joint declaration in regard to France, containing a thinly veiled threat of armed intervention against the revolution.

The Legislative Assembly, which began its sessions on Oct. 1, 1791, was composed of 750 members; it included only inexperienced deputies, inasmuch as members of the Constituent Assembly had voted themselves ineligible for election to the new body. The new legislature was divided into widely divergent factions, the most moderate of which was the Feuillants, who supported a constitutional monarchy as defined under the Constitution of 1791. In the center was the majority caucus, known as the Plain,

which was without well-defined political opinions and consequently without initiative. The Plain, however, uniformly opposed the republican faction that sat on the left, composed mainly of the Girondists (q.v.), who advocated transformation of the constitutional monarchy into a federal republic similar to the United States, and of the Montagnards (see MOUNTAIN, THE), consisting of Jacobins and Cordeliers, who favored establishment of a highly centralized, indivisible republic. Before the differences between the Girondists and the Montagnards attained schismatic proportions, the republican caucus in the assembly secured passage of several important bills, including stringent measures against clergymen who refused to swear allegiance. Louis exercised his veto against these bills, creating a cabinet crisis that brought the Girondists to power. Despite the opposition of leading Montagnards, the Girondist ministry, headed by Jean Marie Roland de la Platière (1734–93), adopted a belligerent attitude toward Frederick William II and Francis II, Holy Roman Emperor, who had succeeded his father Leopold II on March 1, 1792. The two sovereigns openly supported the activities of the émigrés and sustained the opposition of the feudal landlords in Alsace to the revolutionary legislation. Sentiment for war spread rapidly among the monarchists, who hoped for the Revolutionary government to be defeated and the restoration of the old regime, and among the Girondists, who looked to a final triumph over reaction at home and abroad. On April 20, 1792, the Legislative Assembly declared war on the Austrian part of the Holy Roman Empire, beginning the series of conflicts known as the French Revolutionary Wars.

Aided by treasonable errors of omission and commission among the French high command, mostly monarchists, the armies of Austria won several victories in the Austrian Netherlands. The subsequent invasion of France produced major repercussions in the national capital. The Roland ministry fell on June 13, and mass unrest erupted, one week later, into an attack on the Tuileries (q.v.), the residence of the royal family. On July 11, after Sardinia and Prussia joined the war against France, the Legislative Assembly declared existence of a national emergency. Reserves were dispatched to the hard-pressed armies, and volunteers were summoned to Paris from all parts of the country. When the contingent from Marseille arrived, it was singing the patriotic hymn thenceforth known as the "Marseillaise". Popular dissatisfaction with the Girondists, who had rallied to support of the

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monarchy and had dismissed charges of desertion against Lafayette, increased the agitation. On Aug. 10 the discontent, combined with the threat contained in the manifesto of the allied commander, Karl Wilhelm Ferdinand, Duke of Brunswick (1735–1806), to destroy the capital city if the royal family were mistreated, precipitated a Parisian insurrection. The insurgents, led by radical elements of the capital and national volunteers en route to the front, stormed the Tuileries and massacred the king's Swiss Guard. Louis and his family took refuge in the nearby hall of the Legislative Assembly, which promptly suspended the king and placed him in confinement. Simultaneously, the insurrectionists deposed the governing council of Paris, which was replaced by a new provisional executive council. The Montagnards, under the leadership of the lawyer George Jacques Danton, dominated the new Parisian government. They swiftly achieved control of the Legislative Assembly. The assembly shortly approved elections, by universal male suffrage, for a new constitutional convention. Between Sept. 2 and 7, more than 1000 royalists and suspected traitors who had been rounded up in various parts of France, were tried summarily and executed. These "September massacres" were induced by popular fear of the advancing allied armies and of rumored plots to overthrow the Revolutionary government. On Sept. 20 a French army, commanded by General Charles François Dumouriez (1739–1823), checked the Prussian advance on Paris at Valmy.

On the day after the victory at Valmy, the newly elected National Convention (q.v.) convened in Paris. In its first official moves that day, the convention proclaimed establishment of the First Republic and abolished the monarchy. Agreement among the principal convention factions, the Girondists and the Montagnards, extended little beyond common approval of these initial measures. No effective opposition developed, however, to the decree sponsored by the Girondists and promulgated on Nov. 19, which promised the help of France to all oppressed peoples of Europe. Encouraging reports arrived almost weekly from the armies, which had assumed the offensive after the battle at Valmy and had successively captured Mainz, Frankfurt-am-Main, Nice, Savoie, the Austrian Netherlands, and other areas. In the meantime, however, strife steadily intensified in the convention, with the Plain vacillating between support of the conservative Girondists and the radical Montagnards. In the first major test of strength, a majority approved the Montagnard proposal

that Louis be brought to trial before the convention for treason. On Jan. 15, 1793, by an almost unanimous vote, the convention found the monarch guilty as charged, but on the following day, when the nature of the penalty was determined, factional lines were sharply drawn. By a vote of 387 to 334, the delegates approved the death penalty. Louis XVI went to the guillotine on Jan. 21.

Girondist influence in the National Convention diminished markedly after the execution of the king. The lack of unity within the party during the trial had irreparably damaged its national prestige, long at low ebb among the Parisian populace, who favored the Jacobins. The Girondists lost influence also in consequence of the military reverses suffered by the French armies after the declaration of war against Great Britain and the United Netherlands (Feb. 1, 1793) and against Spain (March 7), which, with several smaller states, had entered the counter-revolutionary coalition against France. Jacobin proposals designed to strengthen the government for the crucial struggles ahead met fierce resistance from the Girondists. Early in March, however, the convention voted to conscript 300,000 men and dispatched special commissioners to the various departments for the purpose of organizing the levy. Royalists and clerical foes of the revolution stirred the anti-conscription feelings of peasants in the Vendée into open rebellion. Civil war quickly spread to neighboring departments. On March 18, the Austrians defeated the army of Dumouriez at Neerwinden, and Dumouriez deserted to the enemy. The defection of the leader of the army, mounting civil war, and the advance of enemy forces across the French frontiers inevitably forced a crisis in the convention between the Girondists and the Montagnards, with the latter stressing the necessity of bold action in defense of the Revolution.

The Reign of Terror. On April 6 the convention established the Committee of Public Safety (q.v.) as the executive organ of the republic and reorganized the Committee of General Security and the Revolutionary Tribunal. Agents were sent to the departments to supervise local execution of the laws and to requisition men and munitions. During this period rivalry between the Girondists and the Montagnards became increasingly bitter. A new Parisian outburst, organized by the radical journalist Jacques René Hébert (1755–94) and his extremist colleagues, forced the convention to order the arrest of twenty-nine Girondist delegates and the Girondist ministers Pierre Henri Hélène Marie Le-

brun-Tondu (1763?-93) and Étienne Clavière (1735-93) on June 2. Thereafter the radical faction in control of the government of Paris played a decisive role in the conduct of the Revolution. On June 24 the convention promulgated a new constitution, the terms of which greatly extended the democratic features of the republic. The document was never actually put into effect, however. Leadership of the Committee of Public Safety passed, on July 10, to the Jacobins, who completely reorganized it. Three days later the radical politician Jean Paul Marat, long identified with the Jacobins, was assassinated by the aristocrat Charlotte Corday, a Girondist sympathizer. Public indignation over this crime considerably broadened the Jacobin sphere of influence. On July 27 the Jacobin leader Maximilien Robespierre was added to the Committee of Public Safety, and soon became its dominant member. Robespierre, aided by Louis Saint-Just, Lazare Carnot, Georges Couthon (1755-94), and other prominent Jacobins, instituted extreme policies to crush any possibility of counterrevolution. The powers of the committee were renewed monthly by the National Convention from April, 1793, to July, 1794, a period known in history as the Reign of Terror.

From a military standpoint, the position of the republic was extremely perilous. The enemy powers had resumed the offensive on all fronts. Mainz had been recaptured by the Prussians, Condé-Sur-L'Escaut and Valenciennes had fallen, and Toulon was under siege by the British. Royalist and Roman Catholic insurgents controlled much of the Vendée and Brittany. Caen, Lyons, Marseille, Bordeaux, and other important localities were in the hands of the Girondists. By a new conscription decree, issued on Aug. 23, the entire able-bodied male population of France was made liable to conscription. Fourteen new armies, comprising about 750,000 men, were speedily organized, equipped, and rushed to the fronts. Along with these moves, the committee struck violently at internal opposition. On Oct. 16 Marie Antoinette was executed, and twenty-one prominent Girondists were beheaded on Oct. 31. Beginning with these reprisals, thousands of royalists, nonjuring priests, Girondists, and other elements charged with counterrevolutionary activities or sympathies were brought before revolutionary tribunals, convicted, and sent to the guillotine. Executions in Paris totaled 2639; more than half (1515) of the victims perished during June and July, 1794. In many of the outlying departments, particularly the main centers of royalist insurrection, even harsher treatment was

meted out to traitors, real and suspect. The Nantes tribunal, headed by Jean Baptiste Carrier (1756-94), which dealt most severely with those who aided the rebels in Vendée, sent more than 8000 persons to the guillotine within three months. In the whole of France, revolutionary tribunals and commissions were responsible for the execution of almost 17,000 individuals. Including those who died in overcrowded, disease-ridden prisons and insurgents shot summarily on the field of battle, the victims of the Reign of Terror totaled approximately 40,000. All elements of the opposition suffered from the terror. Of those condemned by the revolutionary tribunals, approximately 8 percent were nobles, 6 percent were members of the clergy, 14 percent belonged to the middle class, and 70 percent were workers or peasants charged with draft dodging, desertion, hoarding, rebellion, and various other crimes. Of these social groupings, the clergy of the Roman Catholic Church suffered proportionately the greatest loss. Anticlerical hatred found further expression in the abolition, in October, 1793, of the Julian calendar, which was replaced by a Republican calendar (q.v.). As a part of its revolutionary program, the Committee of Public Safety, under the leadership of Robespierre, attempted to remake France in accordance with its conceptions of humanitarianism, social idealism, and patriotism. Striving to establish a "Republic of Virtue", the committee stressed devotion to the republic and to victory and instituted measures against corruption and hoarding. In addition, on Nov. 23, 1793, the Commune of Paris, in a measure soon copied by authorities elsewhere in France, closed all churches in the city and began actively to sponsor the revolutionary religion known as the Cult of Reason. Initiated at the insistence of the radical leader Pierre Gaspard Chaumette (1763-94) and his extremist colleagues (among them Hébert), this act accentuated growing differences between the centrist Jacobins, led by Robespierre, and the fanatical Hébertists, a powerful force in the convention and in the Parisian government.

The tide of battle against the allied coalition had turned, meanwhile, in favor of France. Initiating a succession of important victories, General Jean Baptiste Jourdan (1762-1833) defeated the Austrians at Wattignies-La-Victoi on Oct. 16, 1793. By the end of the year, the invaders in the east had been driven across the Rhine and Toulon had been liberated. Of equal significance, the Committee of Public Safety had largely crushed the insurrections of the royalists and the Girondists.

FRENCH REVOLUTION

Struggle for Power. The factional struggle between the Committee of Public Safety and the extreme group surrounding Hébert was resolved with the execution, on March 24, 1794, of Hébert and his principal associates. Within two weeks, Robespierre moved against the Dantonists, who had begun to demand peace and an end of the terror. Danton and his principal colleagues were beheaded on April 6. As result of these purges and wholesale reprisals against supporters of the two factions, Robespierre lost the backing of many leading Jacobins, especially those who feared for their own safety. A number of military successes, notably that at Fleurus, Belgium, on June 26, which prepared the way for the second French conquest of the Austrian Netherlands, increased popular confidence in eventual triumph. In consequence, doubt regarding the necessity of Robespierre's terroristic security measures became widespread. The general dissatisfaction with the leader of the Committee of Public Safety shortly developed into full-fledged conspiracy. Robespierre, Saint-Just, Couthon, and ninety-eight of their followers were seized on July 27, the Ninth Thermidor by the Republican calendar, and beheaded the next day. The Ninth Thermidor is generally regarded as marking the end of the "Republic of Virtue".

Until the end of 1794, the National Convention was dominated by the group, called Thermidoreans, that overthrew Robespierre and ended the Reign of Terror. The Jacobin Clubs were closed throughout France, the Revolutionary tribunals were abolished, and various extremist decrees, including one that had fixed wages and commodity prices, were repealed. After the recall to the convention of expelled Girondists and other rightist delegates, Thermidorean conservatism was transformed into sharp reaction. During the spring of 1795, bread riots and protest demonstrations spread from Paris to many sections of France. The outbreaks were suppressed, and severe reprisals were exacted against the Montagnards.

The morale of the French armies was undamaged by these events on the home front. During the winter of 1794-95, French forces, commanded by General Charles Pichegru (1761-1804), overran the Austrian Netherlands, occupied the United Netherlands, which the victors reorganized as the Batavian Republic, and routed the allied armies of the Rhine. This sequence of reversals resulted in the disintegration of the anti-French coalition. On April 5, 1795, by the Treaty of Basel, Prussia and a number of allied Germanic states concluded peace with the French government. On July 22 Spain

also withdrew from the war, leaving Great Britain, Sardinia, and Austria as the sole remaining belligerents. For nearly a year, however, a stalemate prevailed between France and these powers. The next phase of the struggle opened the Napoleonic Wars (q.v.).

Peace was restored to the frontiers, and in July an invading army of émigrés was defeated in Brittany. The National Convention then quickly completed the draft of a new constitution. Formally approved on Aug. 22, 1795, the new basic law of France vested executive authority in a Directory (q.v.), composed of five members. Legislative power was delegated to a bicameral legislature, consisting of the Council of Ancients, with 250 members, and the Council of the Five Hundred. The terms of one member of the Directory and a third of the legislature were renewable annually, beginning in May, 1797, and the franchise was limited to taxpayers who could establish proof of one-year residence in their voting district. The new constitution contained additional evidence of retreat from Jacobin democracy, and because of failure to provide means of breaking deadlocks between the executive and legislative bodies, it laid the basis for constant intragovernmental rivalry for power, successive coups d'état, and ineffectual administration of national affairs. The National Convention, however, still anticlerical and antiroyalist despite its opposition to Jacobinism, created safeguards against the restoration of the monarchy. By a special decree, the first directors and two thirds of the legislature were to be chosen from among the convention membership. Parisian royalists, reacting violently to this decree, organized, on Oct. 5, 1795, an insurrection against the convention. The uprising was promptly quelled by troops under the command of General Napoléon Bonaparte, a little-known leader of the revolutionary armies who later became Napoleon I, Emperor of France. On Oct. 26 the powers of the National Convention were terminated; on Nov. 2 it was replaced by the government provided for under the new constitution.

Although a number of capable statesmen, including Charles Maurice de Talleyrand-Périgord and Joseph Fouché, gave distinguished service to the Directory, the government encountered from the outset a variety of difficulties. Many of these problems arose from the inherent structural faults of the governmental apparatus; others grew out of the economic and political dislocations brought on by the triumph of conservatism. The Directory inherited an acute financial crisis, which was aggravated by disas-

trous depreciation (about 99 percent) of the assignats. Although most of the Jacobin leaders were dead, transported, or in hiding, the spirit of Jacobinism still flourished among the lower classes. In the higher circles of society, royalist agitators boldly campaigned for restoration. The bourgeois political groupings, determined to preserve their hard-won status as the masters of France, soon found it materially and politically profitable to direct the mass energies unleashed by the revolution into militaristic channels. Old scores remained to be settled with the Holy Roman Empire. In addition, absolutism, by its nature an omnipresent threat to the revolution, still held sway over most of Europe.

The Rise of Napoléon. Less than five months after the Directory took office, it launched the initial phase (March, 1796, to October, 1797) of the Napoleonic Wars (q.v.). The three coups d'état, on Sept. 4, 1797 (the Eighteenth Fructidor), on May 11, 1798 (the Twenty-second Floréal), and on June 18, 1799 (the Thirtieth Prairial), which occurred during this period, merely reflected regroupings of the bourgeois political factions. Military setbacks inflicted on the French armies in the summer of 1799, economic difficulties, and social unrest profoundly endangered bourgeois political supremacy in France. Attacks from the left culminated in a plot initiated by the radical agrarian reformer François Noël Babeuf who advocated equal distribution of land and income. This planned insurrection, called the Conspiracy of the Equals, did not materialize, however, as Babeuf was betrayed by an accomplice and executed on May 28, 1797 (the Eighth Prairial). In the opinion of Lucien Bonaparte, president of the Council of the Five Hundred, of Fouché, minister of police, of Sieyès, then a member of the Directory, and of Talleyrand-Périgord and other political leaders, the crisis could be overcome only by drastic action. A coup d'état on Nov. 9, 1799 (the Eighteenth Brumaire), destroyed the Directory. In these and subsequent events, which culminated on Dec. 24, 1799, in a new constitution and the Consulate (q.v.), General Napoléon Bonaparte, currently the popular idol of the recent campaigns, was a central figure. Vested with dictatorial power as First Consul, he rapidly shaped the revolutionary zeal and idealism of France to his own ends. The partial reversal of the national revolution was compensated for, however, by its extension, during the Napoleonic conquests, to almost every corner of Europe.

Some of the changes that were a result of the French Revolution directly affected the institutions of France and others intangibly influenced

the ideas and actions of succeeding generations. One of the direct results was the abolition of the absolute monarchy in France. The revolution was responsible also for the destruction of the feudal privileges of the nobles. Serfdom was abolished, feudal dues and tithes were eliminated, the large feudal estates were broken up, and the principle of equal liability to taxation was introduced. With the sweeping redistribution of wealth and landholdings, France became the European nation with the largest proportion of small independent landowners. Other social and economic reforms initiated during this period included the elimination of imprisonment for debt, the introduction of the metric system, and the abolition of the rule of primogeniture in the inheritance of land.

Changes Resulting from the Revolution. During the Consulate, Napoléon Bonaparte carried through a series of reforms that were begun during the revolution. He established the Bank of France, which has continued to function, more or less unchanged, up to the present time, as a quasi-independent national bank and as the agent of the French government for currency, public loans, and the deposit of public funds. The present highly centralized, uniform, secularly controlled French educational system was begun during the Reign of Terror and completed by Napoléon; the University of France (see FRANCE: *The People: Education*) and the Institute of France (q.v.) were organized. Teaching appointments, based upon competitive examinations, were opened to all citizens irrespective of birth or wealth. The reform and codification of the diverse provincial and local law, which culminated in the Napoleonic Code, reflected many of the principles and changes introduced during the revolution: equality before the law, right of habeas corpus, and provisions for fair trial. Trial procedure provided for a board of judges and a jury for criminal cases; an accused was considered innocent until proven guilty and was guaranteed counsel.

An additional area in which the revolution played an important part was that of religion. Although not always practiced in the revolutionary period, the principles of freedom of religion and the press, as enunciated in the Declaration of the Rights of Man, resulted ultimately in freedom of conscience and in civil status for Protestants and Jews. The Revolution paved the way also for separation of church and state.

The more intangible results of the revolution were embodied in its watchwords, "Liberty, Equality, Fraternity". These ideals became the platform of liberal reforms in France and Europe

FRENCH REVOLUTIONARY CALENDAR

in the 19th century and remain the present-day passwords of democracy. See separate articles for these individuals whose birth and death dates are not given. See illustrations in full color opposite and next page.

FRENCH REVOLUTIONARY CALENDAR. See REPUBLICAN CALENDAR, FRENCH.

FRENCH REVOLUTIONARY WARS. See FRENCH REVOLUTION.

FRENCH SOMALILAND. See AFARS AND ISSAS, FRENCH TERRITORY OF THE.

FRENCH SOUTHERN AND ANTARCTIC LANDS, overseas territory of France (since 1955), comprising the Kerguelen (q.v.) and Crozet archipelagos and the islands of Saint Paul and Amsterdam in the s. Indian Ocean, and Adélie Land, a narrow segment of the Antarctic continent; total area, about 202,917 sq.mi.

The crozet archipelago, a group of twenty small mountainous islands, is located at about lat. 46° S. and long. 51° E. The climate is characterized by very high humidity and strong winds. Little plant life occurs; animal life consists mainly of elephant seals and various species of birds. Area, about 195 sq.mi.

Amsterdam and St. Paul islands are situated at about lat. 37° S. and lat. 38° S. respectively and about long. 77° E. Both islands are of volcanic origin, and the center of St. Paul is occupied by a large crater with hot springs. The climate is extremely humid and windy, but temperate. Annual temperatures range between 28° F. and 82° F., with a mean summer temperature of 60° F. Vegetation is relatively abundant. On St. Paul tropical vegetation is found in areas affected by volcanic heat. Total area, about 22 sq.mi.

Adélie Land lies on the Antarctic continent s. of lat. 66° S. and between long. 136°20' E. and long. 142°20' E. The terrain consists of a glacier-covered plateau rising to 8200 ft. in the interior. On the coast the temperature varies from -36° F. to 40° F. Winds of up to 125 m.p.h. have been recorded. Mosses and lichens are the only vegetation. Marine animals are abundant, especially penguins. Area, about 200,000 sq.mi.

The only inhabitants of the territory are personnel of the permanent scientific stations located on Kerguelen, the Crozets, Amsterdam, and Adélie Land. The territory is governed by an administrator and a consultative council, both appointed by the French government; the council meets in Paris twice a year.

Amsterdam and St. Paul islands were sighted in 1522 by the Magellan expedition. Kerguelen and the Crozets were discovered in 1772. An expedition under Captain Jules Dumont d'Urville (q.v.) discovered Adélie Land in 1840.

FRENCH SPOILIATION CLAIMS, demands made upon the United States government by American merchants for shipping losses incurred at the hands of the French between 1793 and 1800. The American merchant vessels were sunk by the French, after the United States had been charged by France with violating the terms of a commercial treaty concluded between the two countries in 1778, during the American Revolution. The spoliation claims were settled when the U.S. government effectuated the Louisiana Purchase (q.v.) in 1803, and in addition assumed the claims of the American merchants against the French to the amount of \$3,750,000. Between 1800 and 1850, approximately fifty legislative bills to reimburse the claimants or their descendants came before Congress. Appropriations were voted on two occasions but were vetoed by Presidents James Knox Polk and Franklin Pierce (qq.v.). Finally in 1885, the claims were adjudicated and the descendants of the original claimants were awarded \$4,800,000.

FRENCH SUDAN. See MALI, REPUBLIC OF.

FRENCH TERRITORY OF THE AFARS AND ISSAS. See AFARS AND ISSAS, FRENCH TERRITORY OF THE.

FRENCHTOWN, BATTLE OF, called also the RIVER RAISIN MASSACRE, a minor engagement, followed by a massacre, in the War of 1812 (q.v.). The battle was fought in Frenchtown township (now the town of Monroe), on the Raisin R., in Monroe Co., Mich., about 22 miles southwest of Detroit. On Jan. 18, 1813, about 650 American troops defeated 100 British soldiers and 400 Indians. Two days later the Americans were joined by several hundred men under General James Winchester (1752-1826), and on Jan. 22 the combined force was defeated by a contingent of 500 British soldiers and 600 Indians under General Henry A. Proctor (1765-1859). The American troops surrendered under guaranty of protection against Indian attack, and a large number of the prisoners were taken to Canada, but the wounded were left under the protection of a British officer. The protection proved insufficient, for on the following day the wounded were massacred by the Indians. Of the total American force, 397 were killed or missing, and 537 were captured.

FRENCH UNION, official designation applied to the union created by the constitution of the Fourth Republic and consisting of the Republic of France and the French associated states. See FRANCE: *History: The Fourth Republic: The French Union.*

FRENCH WEST AFRICA, former political entity of the French Union (q.v.). Dakar was the

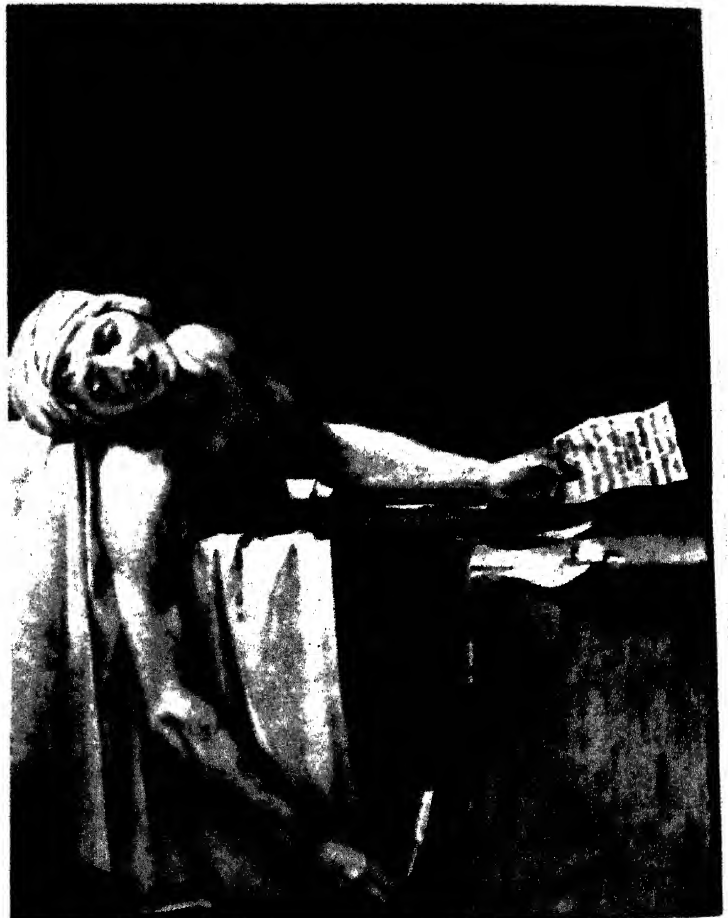


French Revolution. Plate 1. Above: The storming of the Bastille by the people of Paris on July 14, 1789. Below: Louis XVI prepares to mount the steps to the guillotine on Jan. 21, 1793, after being convicted of treason by the National Convention.





French Revolution. Plate 2. Major figures in the political struggle during the French Revolution. Left: Napoléon Bonaparte (from an 18th-century stamp). Center, left: Georges Jacques Danton, leader of the Montagnard faction of the Legislative Assembly. Bottom, left: Maximilien Robespierre, leader of the Reign of Terror. Below: The painting "Death of Marat" (1793), by Jacques Louis David, depicts the Jacobin leader Paul Marat after his assassination by Charlotte Corday.



capital. The region occupied by former French West Africa now comprises the independent republics of Senegal, Mauritania, Guinea, Mali, Niger, Ivory Coast, Dahomey (Benin), and Upper Volta. Area of former French West Africa, 1,815,768 sq.mi.

Although the French had established themselves on the w. coast of Africa as early as the 17th century, they engaged in no considerable colonization until the second half of the 19th century. In 1854 the French soldier and statesman Louis Léon César Faidherbe (1818–89), intent on establishing a French African empire, extended the French possessions eastward from the upper Senegal R. to the upper Niger, and brought under French domination the territory between the Senegal and Gambia rivers. The coastal establishments were expanded by a series of missions and campaigns undertaken between 1876 and 1900. These expeditions included the upper Niger campaigns of 1876–90, in the course of which various native kingdoms of the region were destroyed; the mission of the French explorer Louis Gustave Binger (1856–1936) to the Ivory Coast, resulting in the establishment of a French protectorate (1887–90); the Dahomey campaigns of 1889–94; and the occupation of Timbuktu in 1893. Conventions in 1890 and 1898 between France and Great Britain established the general boundaries of the respective colonial possessions. French West Africa was constituted an administrative entity in 1904. A treaty concluded by France and Great Britain in 1914 defined the Anglo-French boundary from the Niger R. to the Gulf of Guinea. In 1946

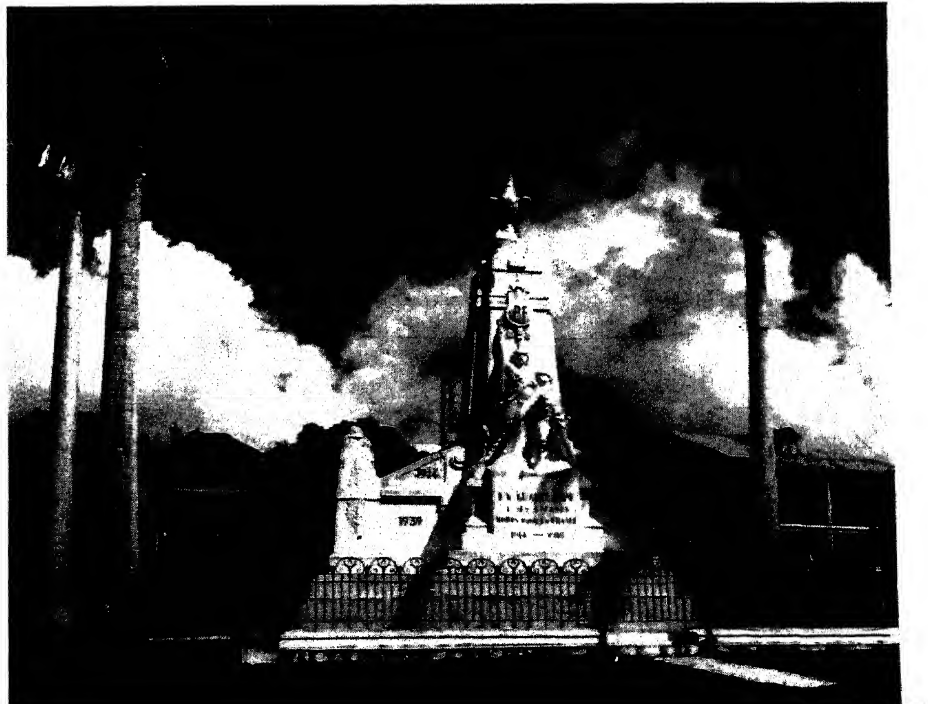
French West Africa became a federation of eight overseas territories of the French Union, which was established pursuant to the constitution of the Fourth French Republic; the territories were Senegal, Mauritania, Guinea, Upper Volta, Sudan, Niger, Ivory Coast, and Dahomey. French West Africa as a whole was administered by a governor-general and each territory also had its separate government. In a referendum held on Sept. 28, 1958, all the territories except Guinea accepted the proposed constitution of the Fifth French Republic. Guinea thereupon became fully independent. In the following year the other territories chose the status of semiautonomous republics in the French Community; in 1960 they became independent republics, with only Senegal choosing to remain a member of the Community; see COMMUNITY, THE.

FRENCH WEST INDIA COMPANY, organization established in 1664 by French Finance Minister Jean Baptiste Colbert (q.v.) for the purpose of trading with the West Indies and Canada. The company soon gained a monopoly (q.v.) on trade with the French colonies, although not with Canada. The charter of the company was revoked in 1674.

FRENCH WEST INDIES, islands of the West Indies, in the Caribbean Sea, belonging to France. These islands, in the Lesser Antilles, are Martinique and Guadeloupe and the five small island dependencies of Guadeloupe: Marie-Galante, Les Saintes, Désirade, Saint Barthélemy, and Saint Martin. During the 17th century the French, in competition with the Spanish, English, Dutch, and Danes, colonized several of the

A war memorial in Basse-Terre, Guadeloupe, in the French West Indies, is dedicated to the soldiers who died for France during World Wars I and II.

British West
Indian Airways



FRENEAU

West Indian islands, including Saint Christopher, Saint Eustatius, Grenada, Dominica, Martinique, Guadeloupe, St. Barthélemy, St. Martin, and Hispaniola. Only Martinique, Guadeloupe, and the nearby small islands, settled in 1635, survived as the French West Indies. In 1775 they were established as separate colonies; see **GUADELOUPE**; **MARTINIQUE**. In 1946, Guadeloupe and dependencies and Martinique were established as separate overseas departments of the Fourth French Republic. The two departments retained this status following the establishment of the Fifth French Republic late in 1958.

FRENEAU, Philip Morin (1752–1832), American poet and journalist, known as the "Poet of the American Revolution", born in New York City, and educated at the College of New Jersey (now Princeton University). His reputation as a satirist was first achieved with a series of vitriolic poems attacking the British, written shortly after the outbreak of the revolution. From 1776 to 1778 he worked as a private secretary in the West Indies; during this period he produced such romantic poems as "The Beauties of Santa Cruz" and "The Jamaica Funeral". Early in 1780, Freneau took part in a privateering expedition to the West Indies. He was captured by the British and imprisoned aboard a ship in New York harbor, obtaining his release in July, 1780. The harsh treatment he received during his confinement provided him with material for *The British Prison-Ship, a Poem in Four Cantos* (1781). While working in the post office at Philadelphia from 1781 to 1784, he continued to produce brilliant, satiric verse in the same patriotic vein. He spent the next six years at sea, and in 1791 Secretary of State Thomas Jefferson (q.v.) appointed him a translator. While serving in that capacity, Freneau founded and was editor of the *National Gazette*, a newspaper which gave forceful expression to the libertarian ideals of Jeffersonian democracy, and which attacked the American statesman Alexander Hamilton and the Federalist Party (qq.v.). He retired in 1793 to his farm in New Jersey, where he spent the remainder of his life except for four years (1803–07) in the coastal trade. Among his most famous individual poems are "The Wild Honeysuckle", "The House of Night", and "The Indian Burying Ground". Collections of his works include *The Poems of Philip Freneau* (1786), *Poems Written between the Years 1768 and 1794* (1795), and *Poems Written and Published During the American Revolutionary War* (2 vol., 1809).

FREON. See **FLUORINE**.

FREQUENCY, term used in the physical sciences to denote the number of times that any

regular recurring phenomenon occurs in a given space of time. The term has wide usage in mechanics, in the study of sound waves and in all branches of radiation.

Vibrations may be of many kinds, ranging from the slow tremors of earthquakes, which may reach a maximum once every several seconds, to the rapid electromagnetic vibrations of light and high-frequency radio. In all forms of mechanical vibration there is a primary relationship between frequency and the physical dimensions of the vibrating object. Thus the time required by a pendulum to make one complete swing is partially determined by the length of the pendulum; the frequency or speed of vibration of a string of a musical instrument is partially determined by the length of the string. In each instance, the shorter the object the higher is the frequency of vibration.

In wave motion of all kinds the frequency of the wave usually is given in terms of the number of wave crests reaching a given point in a second. The velocity of the wave and its frequency and wavelength are interrelated. The wavelength, the distance between successive wave crests, is inversely proportional to frequency and directly proportional to velocity. In mathematical terms, this relationship is expressed by the equation $V = f\lambda$, where V is velocity, f is frequency, and λ is wavelength. From this equation any one of the three quantities can be found if the other two are known.

FREQUENCY OF WAVELENGTH TABLE

Type of Vibration	Approximate f or λ
Ocean tides	1 cycle in 12½ hr.
Tidal wave	1 cycle in 15 min.
Earthquake wave in rock	1 cycle in 20 sec.
Lowest note of organ	16 Hz
Lower limit of normal human ear	25 Hz
"A" above Middle "C"	440 Hz
Upper limit of normal human ear	20 KHz
Ultrasonic range	20 KHz–1000 MHz
Long-wave radio stations	50–550 KHz
Broadcast stations	550–1700 KHz
High-frequency (HF) stations	10–100 meters or 3000 KHz–30 MHz
Very-high-frequency (VHF) stations (FM and television bands)	1–10 meters or 30–300 MHz
Ultra-high-frequency (UHF) stations	10–100 centimeters or 300–3000 MHz
Super-high-frequency band (microwave radar)	1–10 centimeters or 3000–30,000 MHz
Infrared rays	less than 1 mm. to 7500 angstrom units (Å)
Visible red light	6500 Å
Visible violet light	4000 Å
Ultraviolet rays	3500–100 Å
Soft (1250-volt) X-ray	10 Å
Hard (125,000-volt) X-ray	0.1 Å
Million-volt gamma ray	0.0125 Å
Billion-volt cosmic ray	0.0000125 Å

The common term for the expression of frequency is cycles per second (c.p.s.). The correct scientific term for one c.p.s., however, is hertz

(usually abbreviated Hz), in honor of the German physicist Heinrich Rudolph Hertz (q.v.), who first demonstrated the nature of electromagnetic wave propagation. Kiloherz (KHz) or thousands of cycles per second and megahertz (MHz) or millions of cycles per second are employed in describing the frequencies of radio waves, for example, or the limits of response of a phonograph. Radio waves and other types of electromagnetic radiations (q.v.) may be characterized by their wavelengths rather than their frequencies. Electromagnetic waves of extremely high frequencies, such as light and X rays, are usually described in terms of wavelength expressed in angstrom units (hundred-millionths of a centimeter). An electromagnetic wave of one angstrom-unit length has a frequency of about 3000 billion MHz.

See SOUND; ULTRASONICS; VIBRATION; WAVE MOTION.

FREQUENCY MODULATION, system of radio transmission in which the carrier wave is modulated so that its frequency varies with the modulating signal. Colloquially this form of transmission is often called FM.

Electronic engineers knew for many years that a carrier wave could be frequency-modulated; however, the first workable system for radio communication was described by the American inventor Edwin H. Armstrong (q.v.) in 1936. See MODULATION; RADIO.

Frequency modulation has several advantages over the system of amplitude modulation (AM) used in conventional broadcasting. The most important of these advantages results from the fact that an FM system has greater freedom from interference and static. Various electrical disturbances, such as those caused by thunderstorms and automobile-ignition systems, are all amplitude modulated in character and are received as noise by AM receivers. A well-designed FM receiver is not sensitive to such disturbances when it is tuned to an FM signal of sufficient strength. FM broadcasting stations can be operated in the very-high-frequency, short-wave bands at which AM interference is frequently severe. These bands, being relatively much wider than the standard broadcast band, have room for a greater number of broadcasting stations in a given area. The range of transmission on these bands is also limited so that stations operating on the same frequency can be located within a few hundred miles of each other without mutual interference.

These factors, coupled with the comparatively low cost of equipment for an FM broadcasting station, resulted in a phenomenal growth of FM

broadcasting in the years following World War II. Within three years after the close of the war there were 600 licensed FM stations broadcasting in the United States. Many of these stations, with potential listening audiences limited to a restricted area, were able to place great emphasis on programs devoted to public service, such as educational and farm programs.

Because of the crowding in the standard broadcast band and the inability of standard AM receivers to eliminate noise, the tonal fidelity of standard stations is purposely limited. FM does not have these drawbacks and therefore can be used to transmit musical programs that reproduce the original performance with a degree of fidelity that cannot be reached on AM bands. In 1961 the Federal Communications Commission (q.v.) authorized FM stereophonic broadcasting. The second sound channel is transmitted by a 38-kilocycle AM subcarrier signal added to the normal FM signal.

FRESCO (It. *fresco*, "fresh"), method or art of painting with watercolors on plaster while the plaster is still wet, or fresh. The term is also applied to the painting executed in this manner. In the Renaissance (q.v.) this process was termed true fresco or *buono fresco*, in order to differentiate it from *fresco secco*, the process of painting on dry plaster. The term fresco is also sometimes used, improperly, for tempera painting (q.v.), or distemper, that is, watercolors mixed with egg or other glutinous substances and executed, not on the plaster coating of a wall, but directly on brick or stone surfaces.

In executing fresco, the painter applies to the wet plaster surface a sketch, or cartoon, of the painting, or part of such sketch. He then indents the outlines of the various figures and forms of the sketch upon the plaster surface with a pointed implement of wood or bone. Next, he removes the sketch and applies the colors; in this latter task he is often aided by a drawing indicating the color scheme to be used. As the moisture in the plaster dries, the lime in the plaster reacts chemically with the carbon dioxide in the air to form calcium carbonate; this compound forms a film over the colors, which binds them to the plaster, that is, makes them part of its very surface, and also gives the colors an unusual clarity. The colors of a fresco are usually thin, transparent, and light; following the Renaissance, methods were found to give the colors somewhat greater opacity. The advantages of fresco painting are the clarity of the colors, the uniformity in texture of the painted surface, and elimination of the undue glossiness that is sometimes found in oil painting.



A detail from "The Tribute Money" (about 1427), a famous fresco by Masaccio in the Brancacci Chapel of Santa Maria del Carmine, Florence.

Scala Fine Arts

In fresco painting, the artist must work quickly and confine himself to essentials in his work. Great dexterity and speed are required of a fresco painter. In addition, he must be skillful enough to know precisely how much watercolor the plaster will absorb. Too much paint causes the plaster to lose its power to bind the colors to its surface, and causes the surface to become "rotten". In such cases cutting away the defective portion, laying on fresh plaster, and doing the painting over is necessary. Retouching may be done on the dried plaster.

In addition to being used for retouching true fresco, *fresco secco* is the method ordinarily employed at present for decorating house walls. In this process, the dry plaster is first rubbed with pumice stone to remove the crust, and then washed with a thin mixture of water and lime. The colors are applied on this surface. The effect of *fresco secco* is inferior to true fresco; the colors are not as clear, and because the protecting crust is thin, the painting has less durability.

History. Fresco painting dates back to ancient times; it was known to the Egyptians, Cretans,

and Greeks. The palace at Knossós, Crete, has a series of frescoes dating from 1600 B.C., vividly depicting scenes and costumes of the time. The Romans also practiced fresco painting, the only extant examples of which have been found in Herculaneum and Pompeii. Whether these paintings were executed in the medium of watercolor or by the use of pigments mixed with wax is not definitely known. The early Christians (2nd century A.D.) used frescoes to decorate the walls of the catacombs, or underground vaults, in which they buried their dead; examples of such frescoes have been found in the catacombs of Rome and Naples. The art of fresco painting was neglected during most of the Middle Ages, but in the late 13th century the art experienced a great revival in Italy; the period extending from this time to the end of the 16th century marked the peak of the development of fresco painting. The artists who began the revival were the Florentine painters Giovanni Cimabue and Giotto (qq.v.), who painted numerous fine examples in churches in Assisi, Florence, and Pisa. The 15th century saw the art at its best in Florence, where it was practiced notably by Masaccio, Benozzo Gozzoli, Pinturicchio (qq.v.), and Domenico di Tommaso Ghirlandajo

(see under GHIRLANDAJO). Among the supreme achievements in fresco painting are the frescoes by the Italian painter Raphael (q.v.) in the Vatican and the fresco *The Last Judgment* and the ceiling frescoes by the Italian artist Michelangelo (q.v.) in the Sistine Chapel of the Vatican. One of the greatest of all fresco painters was the Italian painter Antonio Allegri da Correggio (q.v.), whose "Ascension of Christ", for the cupola of the church of San Giovanni, Parma, and "Assumption of the Virgin", for the cupola of the Cathedral of Parma, are among the finest frescoes ever painted.

Fresco painting was widely practiced in Europe in the 18th century, although it had lost its grandeur of style and had become the medium for superficial, if charming, decoration. The outstanding painters of fresco in this period were Giovanni Battista Tiepolo (q.v.) in Italy and the French rococo (q.v.) painters, including Jean Honoré Fragonard and François Boucher (qq.v.). In the 19th century the art was revived and restored to its early dignity by the painters of the German Pre-Raphaelite school (see PRE-RAPHAELITES). Fresco was given further impetus by Louis I, Duke of Bavaria (see under LOUIS), who had numerous churches, palaces, and museums decorated by this method. The most important center for fresco painting in the 20th century has been Mexico. Two Mexican painters in particular, Diego Rivera and José Clemente Orozco (qq.v.), were outstanding fresco painters. Among the frescoes executed by these two artists in public buildings in Mexico and the United States are the frescoes by Orozco in the New School for Social Research, New York City, and those by Rivera in the Luncheon Club of the Stock Exchange, San Francisco, and in the Detroit Institute of Fine Arts.

FRESNEL, Augustin Jean (1788–1827), French physicist, born in Broglie, Eure-et-Loir, and educated at Caen and at the École Polytechnique in Paris. He served as a government engineer but, because of his Royalist sympathies, lost his appointment on the return of Napoleon I (q.v.), Emperor of France, from Elba in 1815. Fresnel was reappointed under Louis XVIII (q.v.), King of France. About this period Fresnel began the extensive researches into various phenomena of light (q.v.), which made him famous. As an adherent of the wave theory of light, he made numerous experiments in the interference of light; in an experiment conducted with the French physicist Dominique Arago (q.v.) Fresnel was the first to demonstrate that two beams of light polarized in different planes do not exhibit interference effects. From this experiment he cor-

rectly deduced that the wave motion of light is transverse, rather than longitudinal (like that of sound) as had been previously believed. Fresnel was the first to produce circularly polarized light. He also worked out a number of basic optical formulas including those for reflection, refraction, double refraction, and the polarization of light reflected from a transparent substance. Fresnel's work on optical effects caused by the motion of objects was important in the later development of the theory of relativity (q.v.). In the field of applied optics, Fresnel designed the type of compound lens, often called a Fresnel lens, that is used to produce parallel beams of light from lighthouses and in a type of spotlight frequently used in theatrical lighting. Fresnel's scientific work was known only to a small group of scientists during his lifetime, and some of his papers were not published until after his death. He was a notable member of the French Academy of Sciences and of the Royal Society of London.

FRESNO, city in California, and county seat of Fresno Co., in the San Joaquin Valley, 189 miles S.E. of San Francisco and 221 miles N. of Los Angeles. It is served by railroad and has a municipal airport. The city is the center of an extensively irrigated and fertile agricultural region which leads the country in grape production. The surrounding region also contains several oil fields. The principal industrial activities in Fresno are the processing and packing of raisins and other fruit and the making of wine. Bricks, farm implements, wine-making and packing-house machinery, soap, wood products, fertilizers and insecticides, and plastics are manufactured. Fresno is the site of Fresno State College, established in 1911, and a city junior college, established in 1910. The University of California maintains an irrigated farm at Kearney Park. The West Coast Relays, leading track and field events of the West, are held each spring at Fresno. Scenic recreational areas accessible from Fresno include Kings Canyon and Sequoia national parks in the Sierra Nevada (q.v.), about 70 miles E. of the city. Fresno was founded and incorporated in 1872, and became the county seat in 1874. In 1885 it was incorporated as a city. Pop. (1960) 133,929; (1970) 165,972.

FREUD, Sigmund (1856–1939), Austrian physician and founder of psychoanalysis, born of Jewish parents in Freiberg (now Příbor, Czechoslovakia), and educated at the University of Vienna. When he was three years old his parents, in flight from the anti-Semitic riots then raging in Freiberg, took him to Leipzig. After a

FREUD

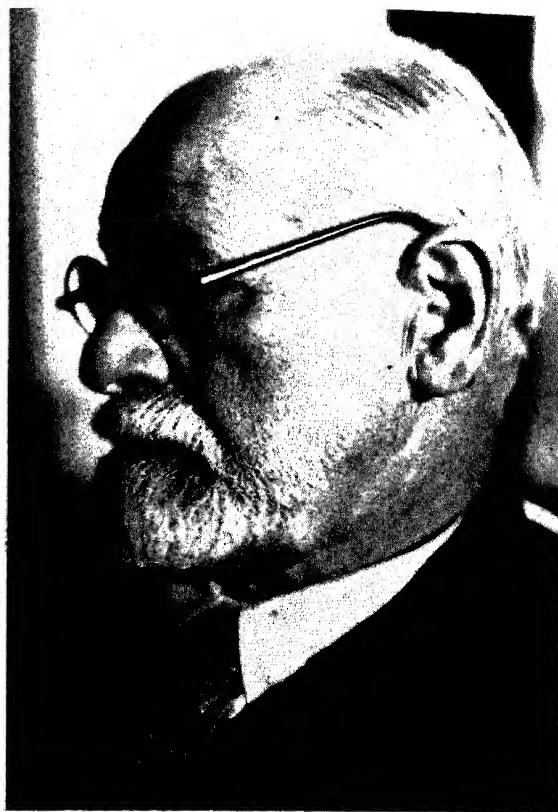
brief stay in Leipzig the family settled in Vienna, where Freud remained for most of his life.

Although his ambition from childhood had been a career in law, he decided to become a medical student shortly before he entered the University of Vienna in 1873. Inspired by the scientific investigations of the German poet Johann Wolfgang von Goethe (q.v.), Freud was driven by an intense desire to study natural science and to solve some of the challenging problems confronting contemporary physical scientists. His choice of medicine as a profession represented, therefore, a practical decision to pursue theoretical studies rather than keen interest in a medical career.

In his third year at the university he began research work on the central nervous system in the physiological laboratory under the direction of the German physician Ernst Wilhelm von Brücke (1819–92). Neurological research was so engrossing that Freud neglected the prescribed courses and as a result remained in medical school three years longer than was required normally to qualify as a physician. In 1881, after completing a year of compulsory military service, he received his medical degree. Unwilling to give up his experimental work, however, he remained at the university as a demonstrator in the physiological laboratory. In 1883, at Brücke's urging, he reluctantly abandoned theoretical research to gain practical experience.

Freud spent three years at the General Hospital of Vienna, devoting himself successively to psychiatry, dermatology, and nervous diseases. In 1885, following his appointment as a lecturer in neuropathology at the University of Vienna, he left his post at the hospital. Later the same year he was awarded a government grant enabling him to spend nineteen weeks in Paris as a student of the French neurologist Jean Martin Charcot (q.v.). Charcot, who was the director of the clinic at the mental hospital, the Salpêtrière, was then treating nervous disorders by the use of hypnotic suggestion; see HYPNOSIS. Freud's studies under Charcot, which centered largely on hysteria (q.v.), influenced him greatly in channeling his interests into the field of psychopathology.

In 1886 Freud established a private practice in Vienna specializing in nervous disease. He met with violent opposition from the Viennese medical profession because of his strong support of Charcot's unorthodox views on hysteria and hypnotherapy. The professional resentment he incurred was to delay any acceptance of his subsequent findings on the origin of neurosis.



Sigmund Freud

Wide World

The Beginning of Psychoanalysis. Freud's first published work, *On Aphasia*, appeared in 1891; it was a study of the neurological disorder in which the ability to pronounce words or to name common objects is lost as a result of organic brain disease; see APHASIA. His final work in neurology, an article, "*Infantile Cerebral Paralysis*", was written in 1897 for an encyclopedia only at the insistence of the editor, as by this time Freud was occupied largely with psychological rather than physiological explanations for mental disorders. His subsequent writings were devoted entirely to that field, which he had named "psychoanalysis" in 1896.

Freud's new orientation was heralded by his collaborative work on hysteria with the Viennese physician Josef Breuer (1842–1925). The work was presented in 1893 in a preliminary paper and two years later in an expanded form under the title *Studies on Hysteria*. In this work the symptoms of hysteria were ascribed to manifestations of undischarged emotional energy associated with forgotten psychic traumas. The therapeutic procedure involved the use of a hypnotic state in which the patient was led to recall and reenact the traumatic experience, thus discharging by catharsis the emotions caus-

ing the symptoms. The publication of this work marked the beginning of psychoanalytic theory formulated on the basis of clinical observations.

During the period from 1895 to 1900 Freud developed many of the concepts that were later incorporated into psychoanalytic practice and doctrine. Soon after publishing the studies on hysteria he abandoned the use of hypnosis as a cathartic procedure; Freud substituted the investigation of the patient's spontaneous flow of thoughts, called free association, to reveal unconscious mental processes as the root of the neurotic disturbance. See UNCONSCIOUS, THE. In his clinical observations he found evidence for the mental mechanisms of repression and resistance. He described repression as a device operating unconsciously to make the memory of painful or threatening events inaccessible to the conscious mind. Resistance is defined as the unconscious defense against awareness of repressed experiences in order to avoid the resulting anxiety. He traced the operation of unconscious processes, using the free associations of the patient to guide him in the interpretation of dreams and slips of speech. Dream analysis led to his discoveries of infantile sexuality and of the so-called Oedipus complex, which constitutes the erotic attachment of the child for the parent of the opposite sex, together with hostile feelings toward the other parent. In these years he also developed the theory of transference, the process by which emotional attitudes, established originally toward parental figures in

childhood, are transferred in later life to others. The end of this period was marked by the appearance of Freud's most important work, *The Interpretation of Dreams* (1900). In this book Freud analyzed many of his own dreams recorded in the three-year period of his self-analysis, begun in 1897. This work expounds all of the fundamental concepts comprising the foundations of psychoanalytic technique and doctrine.

In 1902 Freud was appointed a full professor at the University of Vienna. This honor was granted him not in recognition of his contributions but as a result of the efforts of a highly influential patient. The medical world still regarded his work with hostility, and his next writings, *The Psychopathology of Everyday Life* (1904) and *Three Contributions to the Sexual Theory* (1905), only increased this antagonism. As a consequence, Freud continued to work virtually alone in what he termed "splendid isolation".

By 1906, however, a small number of pupils and followers had gathered around him, including the Austrian psychiatrists William Stekel (1868–1940) and Alfred Adler, the Austrian psychologist Otto Rank, the American psychiatrist Abraham Arden Brill, and the Swiss psychiatrists Paul Eugen Bleuler and Carl Gustav Jung (qq.v.). Other notable associates, who joined the circle in 1908, were the Hungarian psychiatrist Sándor

The consulting room of Sigmund Freud in Vienna, Austria.
Edmund Engelman



Ferenczi (1873–1933) and the British psychiatrist Ernest Jones (1879–1958).

Psychoanalysis Gains International Acceptance. Increasing recognition of the so-called psychoanalytic movement made possible the formation in 1910 of a worldwide organization called the International Psychoanalytic Association. As the movement spread, gaining new adherents through Europe and the United States, Freud was troubled by the dissension that arose among members of his original circle. Most disturbing were the defections from the group of Adler and Jung, each of whom developed a different theoretical basis for disagreement with Freud's emphasis on the sexual origin of neurosis. Freud met these setbacks by developing further his basic concepts and by elaborating his own views in many publications and lectures.

After the onset of World War I Freud devoted little time to clinical observation and concentrated on the application of his theories to the interpretation of religion, mythology, art, and literature. In 1923 he was stricken by cancer of the jaw, which necessitated constant, painful treatment in addition to many surgical operations. Despite his physical suffering he continued his literary activity for the next sixteen years, writing mostly on cultural and philosophical problems. When the Germans occupied Austria in 1938, Freud escaped to England, where he remained until his death.

Freud created an entirely new approach to the understanding of human personality by his demonstration of the existence and force of the unconscious. In addition, he founded a new medical discipline; he formulated basic therapeutic procedures that in modified form are applied widely in the present-day treatment of neuroses and psychoses. Although never accorded full recognition during his lifetime, Freud is generally acknowledged as one of the great creative minds of modern times.

Among his other works are *Totem and Taboo* (1913), *Ego and the Id* (1923), *New Introductory Lectures on Psychoanalysis* (1933), and *Moses and Monotheism* (1939).

See also PSYCHOANALYSIS; PSYCHOTHERAPY.

W.C.M. & P.Ga.

FREY or FREYR, in Norse religion and mythology, son of the fertility god Njord. Frey was the god of fruitfulness, prosperity, and peace, and the bestower of sunlight and rain. He awakened the earth from the long sleep of winter and prayers for a bountiful harvest were addressed to him. His sister was Freya, and his wife, Gerth. Frey was the patron god of Sweden and his chief shrine was at Uppsala.

FREYTAG, Gustav (1816–95), German writer, born in Kreuzburg (now Kluczbork, Poland), and educated at the universities of Breslau (now Wrocław) and Berlin. In 1839 he became an instructor in German language and literature at the University of Breslau. From 1848 to 1870 he was editor with the German literary historian Julian Schmidt (1818–86) of *Die Grenzboten* ("The Border Messengers"), an influential liberal weekly. For this publication he wrote a series of sketches on German history designed to arouse patriotic nationalism; the series was published as *Bilder aus der Deutschen Vergangenheit* (5 vol., 1859–67; Eng. trans., *Pictures of German Life*, 4 vol., 1862–63) and became one of the most popular books in Germany at the time. Among his other works are the comedies *Die Brautfahrt* ("The Honeymoon", 1844) and *Die Journalisten* (1855; Eng. trans., *The Journalists*, 1888); the novels *Soll und Haben* (1855; Eng. trans., *Debit and Credit*, 1856) and *Die Verlorene Handschrift* (1864; Eng. trans., *The Lost Manuscript*, 1865); the autobiography *Erinnerungen aus Meinem Leben* (1887; Eng. trans., *Reminiscences of My Life*, 1890); and the critical work *Technik des Dramas* (1863; Eng. trans., *Technique of the Drama*, 1895).

FRIAR (Lat. *frater*, "brother"), term applied to members of certain religious orders who practice the principles of monastic life (see MONASTICISM) and devote themselves to the service of humanity in the secular world. Originally, their regulations forbade the holding either of community or personal property, and the resulting dependence of friars upon voluntary contributions in order to live caused them to be known as mendicant orders. The founders of the orders used the term "friar" to designate members; Saint Francis of Assisi (q.v.) called his followers Friars Minor, and Saint Dominic (q.v.) used the name Friars Preachers. The larger orders were given popular names, derived usually from the color or other distinguishing marks of their habits, such as Black Friars (Dominicans), Gray Friars (Franciscans), and White Friars (Carmelites). Friars differed from monks in that the monk was attached to a specific community within which he led a cloistered life, having no direct contact with the secular world. The friar, on the other hand, belonged to no particular monastic house but to a general order, and worked as an individual in the secular world. In effect, the distinction between monks and friars is presently valid only between the strictest orders of monks and friars.

See CARMELITES; DOMINICANS; FRANCISCANS; MENDICANT FRIARS.

FRICK, Henry Clay (1849–1919), American industrialist and philanthropist, born in Westmoreland County, Pa. In 1871 he organized the H. C. Frick Coke Company, which became one of the largest coke-producing firms in the world. The financial panic of 1873 enabled Frick to acquire the properties of his rivals and so to arrange an alliance, on very favorable terms, with the steel firm of Carnegie Brothers. He was chairman of the board of directors of the Car-



Henry Clay Frick

gie firm from 1889 to 1900, and during this period his actions in handling the Homestead (Pa.) Strike of 1892 led to an attempt at his assassination by the anarchist Alexander Berkman (1870–1936). Frick was a director of many companies, and in 1901 took a prominent part in the negotiations that resulted in the formation of the United States Steel Corporation. On his death he left land and an endowment to provide a park in Pittsburgh, Pa., and bequeathed his house, with its notable collection of paintings and objets d'art, to the City of New York. The bequest, now known as the Frick Collection, is associated with the Frick Art Reference Library, endowed in his memory in 1919 by his daughter.

FRICTION, in mechanics, resistance to the sliding, rolling, or flowing motion of a body in relation to another body with which it is in contact; see MECHANICS.

In any solid the molecules display internal friction. This form of friction is the force that causes any vibrating object, such as a piano

string or a tuning fork, to stop vibrating; see VIBRATION. Internal friction in liquids and gases is called viscosity (q.v.).

External friction is of two kinds, sliding friction and rolling friction. In sliding friction, the resistance is caused by the interference of irregularities on the two surfaces. In rolling friction the resistance is caused by the interference of small deformations or indentations formed as one surface rolls over another. In both forms of friction molecular attraction between the two surfaces causes some resistance. The frictional resistance in either case is directly proportional to the force pressing the two objects against each other. Friction between any two surfaces is measured in terms of the coefficient of friction, the ratio between the force required to move two surfaces in contact with each other and the force holding the two surfaces together. If a 50-lb. weight is resting on a flat surface and it requires a force of 10 lb. to move the weight along the surface, the coefficient of friction between the weight and the surface is 10 divided by 50, or 0.2. The coefficient of friction between two wood surfaces is about 0.35, between leather and metal about 0.55, between two stone or brick surfaces about 0.65, between smooth, well-oiled metallic surfaces 0.01 to 0.05, and between ball bearings and a bearing race in rolling contact about 0.002; see BEARING. The friction between two objects is at maximum just before they begin to move in relation to each other and less when the objects are in motion. The maximum value of friction is called static friction, or friction of rest, and the value of friction between moving objects, kinetic friction or friction of motion; see KINETIC THEORY. Motion between two bodies is discontinuous and kinetic friction may be regarded as a series of static frictions.

The angle of friction is the angle to which a surface must be tilted before an object placed on the surface will slide steadily down the surface. This angle measures the effectiveness of friction in overcoming the force of gravity which tends to make the object slide down the tilted surface. See LUBRICANTS.

FRIDAY (AS., *frīgedaeg*; from OHG. *Frīa*, a goddess; OE. *daeg*, "day"), English name of the sixth day of the week. The day was held sacred to Venus (q.v.), the goddess of love, by the Romans, who called it *dies veneris* (day of Venus). In the Romance languages the name of the day is derived from the Latin, as in the French *vendredi*, the Italian *venerdì*, and the Spanish *viernes*. Among the Germanic peoples the day was held sacred to the Norse goddess of love,

FRIDLEY

Frigga, or Fria. The Germanic languages, like English, use variations of the Old High German *frīatag* (day of Fria) to designate the day. The Hebrew name for Friday, *yom shishi*, means simply "sixth day". Among many Slavic peoples, however, Friday is not regarded as the sixth day of the week, as evidenced by its Russian name, *pyatnietza*, literally "fifth day". Friday is the Muslim Sabbath (q.v.) and is the day for religious gatherings. The day was chosen by the Prophet Muhammad (q.v.) in commemoration of the creation of man on the "sixth day" of creation (q.v.), and to differentiate his followers from Christians and Jews.

In the Christian religion the day is consecrated to the memory of the crucifixion of Christ (see GOOD FRIDAY). The Greek theologian Clement of Alexandria (q.v.) and other early writers indicate that from the early days of Christianity, Friday was observed by fasting and prayer. In the Greek Orthodox Church, as was formerly the practice in the Roman Catholic Church, Friday is a day of abstinence from the eating of meat, except when it coincides with a major feast day, such as Christmas.

Friday has long been regarded as an unlucky day. This superstition is attributed by some to the occurrence of the crucifixion of Christ on that day. The superstition may have been strengthened by the fact that Friday was for many years the day of execution of criminals and was commonly called "hangman's day".

FRIDLEY, city of Minnesota, in Anoka Co., on the Mississippi R., about 7 miles N. of central Minneapolis. The city manufactures naval ordnance and rotary pumps. Located in a farming region, grain and livestock are raised. Fridley was incorporated in 1949. Pop. (1960) 15,173; (1970) 29,233.

FRIED, Alfred Hermann (1864–1921), Austrian pacifist and publicist, born in Vienna. In 1883 he settled in Berlin as a bookdealer and writer, and in 1891 he founded and edited the first German pacifist periodical, *Die Waffen Nieder!* ("Lay Down Your Arms!"), the title of which was changed in 1899 to *Die Friedenswarte* ("The Watchtower for Peace"). In 1892 he organized the Deutsche Friedensgesellschaft, a German peace society, and from that time became a leading participant in the international peace movement, producing more than seventy pamphlets and books and about 2000 newspaper articles advocating the cause of peace among nations. He had a great influence on the study of international law in Germany, and shared the 1911 Nobel Peace Prize with the Dutch jurist Tobias Michael Carel Asser (q.v.). Among the

important works by Fried are *Handbuch der Friedensbewegung* ("Handbook of the Peace Movement", 1905), *Der Kaiser und der Weltfrieden* ("The Kaiser and World Peace", 1910), and *Der Weltprotest gegen den Versailler Frieden* ("The World Protest Against the Peace of Versailles", 1920).

FRIEDMAN, Milton (1912–), American economist, born in New York City, and educated at Rutgers University and the University of Chicago. Friedman worked as an economist with various Federal agencies in Washington, D.C., from 1935 to 1940 and from 1941 to 1943. In 1946 he joined the economics department at the University of Chicago. He is considered a leading protagonist of the economic theory that free market forces, rather than increased government intervention, can most effectively produce a balanced and noninflationary rate of economic growth. Friedman maintains that the supply of money in circulation is a key determinant in economic growth. He is the outstanding exponent of the policy that the Federal Reserve System (q.v.) can best promote economic stability by increasing the supply of money at a fairly fixed rate instead of sharply expanding or contracting it. Among his books are *Capitalism and Freedom* (1962), *A Monetary History of the United States, 1867–1960* (1963), *Dollars and Deficits* (1968), and *A Theoretical Framework for Monetary Analysis* (1971).

FRIEDRICHSHAFEN, city of West Germany, in Baden-Württemberg State, on the E. shore of Lake Constance, 80 miles S.E. of Stuttgart. Friedrichshafen was formed in 1811 from the town of Buchhorn, founded in the 9th century and declared a free city of the Holy Roman Empire in 1275, and the monastery and village of Hofen. Friedrichshafen is a railway junction, vacation resort, and commercial lake port. Manufactures include airplanes, motors, and furniture. The city is known as the site of the former Zeppelin airship (qq.v.) works and was the starting point of several famous flights by the *Graf Zeppelin* under the command of the German airship designer and navigator Hugo Eckener (q.v.). During World War II the town was subjected to aerial bombardment by the Allies. Following the war, Friedrichshafen was included in the French occupation zone of Germany. Pop. (1971 est.) 49,000.

FRIENDS SERVICE COUNCIL, THE. See FRIENDS, SOCIETY OF.

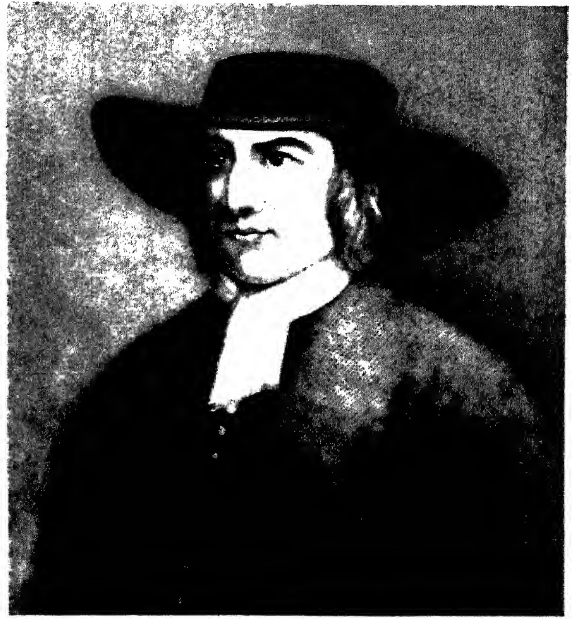
FRIENDS, SOCIETY OF, in full RELIGIOUS SOCIETY OF FRIENDS, designation of a sect of Christians more commonly known as Quakers. The fundamental belief of Quakerism is that Di-

vine revelation is immediate and individual; any person may perceive the word of God in his soul, and Friends endeavor to heed it. Terming such revelation the "inward light", the "Christ within", or the "inner light", the first Friends identified this spirit with the Christ of history. They rejected a formal creed, worshiped on the basis of silence, and regarded every participant as a potential vessel for the word of God, instead of relying upon a special, paid clergy set apart from the rest.

Beliefs. Quakerism emphasizes the goodness of man, because of a belief that there is that of God in everyone. It recognizes, however, that there is often also evil in man. It works to raise up the good and push down the evil. Quakerism is a way of life; Friends place great emphasis upon living in accord with Christian principles. Truth and sincerity are Quaker bywords; thus, Quaker merchants refuse to bargain, for bargaining implies that truth is flexible. Emulating Christ, the Friends attempted to avoid luxury and emphasized simplicity in dress, manners, and speech. Until late in the 19th century, they employed certain mannerisms of speech known as plain speech that employed "thee" as opposed to the more formal "you"; this usage indicated the leveling of social classes and the spirit of brotherhood integral to Quaker teaching.

In the administration and privileges of the society, no distinction between the sexes is made. The qualifications for membership are based on moral and religious grounds, and on the readiness of the candidate to realize and accept the obligations of membership. Meetings for worship are held regularly, usually once or twice a week, and are intended to help each member to feel God's presence as a guiding spirit directing his life. In these meetings the members measure their insights and beliefs against those of the meeting as a whole. Because the religion of the Quakers was founded as a completely spiritual belief requiring no physical manifestation, the meetings have traditionally had no prearranged program, sermon, liturgy, or outward rites. Today, however, more than one-half of the Friends in the United States use paid ministers and conduct meetings for worship in a programmed or semiprogrammed manner.

In both the unprogrammed and programmed meetings a great deal of responsibility is accepted by the membership. A group called Worship and Ministry, or Ministry and Oversight, accepts considerable responsibility for the spiritual life of the meeting. Overseers undertake to provide pastoral care for the membership or share in that care when there is a reg-



George Fox formulated in his Paper of Advice (1668) ideas that led to the organization of the Society of Friends.

Bettmann Archive

ular pastor. The religious discipline and administration of the society are regulated by periodic meetings known as Meetings for Business. One or more congregations constitute a Monthly Meeting, one or more Monthly Meetings form a Quarterly Meeting, and the Quarterly Meetings within a stated geographical area form a Yearly Meeting of the Religious Society of Friends. The decisions of the Yearly Meeting are the highest authority for all doctrinal or administrative questions raised in any subsidiary meeting within its jurisdiction. Usually no voting takes place in Quaker meetings; members seek to discover the will of God by deliberation concerning any matter at hand. As an integral part of Quaker doctrine, at meetings members are regularly and formally queried on their adherence to Quaker principles. These queries relate to such matters as the proper education of their children, the use of intoxicants, care of the needy, and, on a broader scale, racial and religious toleration and the treatment of all offenders in a spirit of love rather than with the object of punishment.

Origins. The Society of Friends may be traced to the many Protestant sects that appeared in Europe during the Reformation (q.v.). These sects, stressing an individual approach to religion, strict discipline, and the rejection of an authoritarian church, formed one expression of the religious temper of 17th-century England. Many of the doctrines of the Society of Friends

FRIENDS, SOCIETY OF

were taken from those of earlier sects, particularly those of the Anabaptists (q.v.) and Independents, who believed in lay leadership, independent congregations, and complete separation of church and state. The society, however, unlike many of its predecessors, did not begin as a formal religious organization. Originally, the Friends were the followers of George Fox (q.v.), an English lay preacher who, about 1647, began to preach the doctrine of "Christ within"; this concept later developed as the idea of the "inner light". Although Fox did not intend to establish a separate sect, his followers soon began to group together into the semblance of an organization, calling themselves by such names as Children of Light, Friends of Truth, and, eventually, Society of Friends. In reference to their agitated movements before moments of Divine revelation, however, they were popularly called Quakers. The first complete exposition of the doctrine of "inner light" was written by the Scottish Quaker Robert Barclay (q.v.) in *An Apology for the True Christian Divinity, as the Same Is Held Forth and Preached by the People Called in Scorn Quakers* (1678), considered the greatest Quaker theological work.

The Friends were persecuted from the time of their inception as a group. They interpreted the words of Christ in the Scriptures literally, particularly: "Swear not at all" (Matt. 5:34), and "Resist not evil" (Matt. 5:39). They refused, therefore, to take oaths; preached against war, even to resist attack; and often found it necessary to oppose the authority of church or state. Because they rejected any organized church, they would not pay tithes to the Church of England (q.v.). Moreover, they met publicly for worship, a contravention of the Conventicle Act of 1664, which forbade meetings for worship other than that of the Church of England. Nevertheless, thousands of people, some on the continent of Europe and in America as well as in the British Isles, were attracted by teachings of the Friends. Many Friends emigrated to America, particularly to Pennsylvania, which the English Quaker William Penn (q.v.) founded as a Quaker refuge.

History. As a formal organization, the Society of Friends dates from 1668, when the body now called London Yearly Meeting came into being under the leadership of George Fox. New England Yearly Meeting claims that it dates from 1661. Fox decided to organize what had been only a movement before, in order to preserve his following in the face of severe persecution in Restoration England.

During the 17th century, the Friends were

known for their religious zeal and missionary work. Their proselytizing, however, diminished in the 18th century. Because, in England, they were excluded from political life by their refusal to take oaths, and because their strict discipline permitted few cultural pursuits, they kept to themselves and devoted themselves mainly to trade, philanthropy, the founding of schools, and management of their religious affairs. Their unadorned dress and archaic speech made them appear strange. After the repeal in 1828 of the Test Acts, which required public officials to pass a religious test, and a ruling by Parliament in 1833 that Friends could affirm instead of taking an oath, Quakers began to enter actively into political and public life.

The 19th century also witnessed differences of opinion concerning doctrine among the Friends. About 1827, in the United States, the Quaker minister Elias Hicks (q.v.) became involved in a schism by questioning the authenticity and Divine authority of the Bible and the historical Christ; many Friends seceded with Hicks, mainly because of their belief in his views, but also because of their insistence that he had a right to hold these views. This schism alarmed the rest of the society, who became known as Orthodox Friends, and a counter-movement was begun to relax the formality and discipline of the society, with a view to making Quakerism more evangelical. The evangelical movement, led by the British Quaker philanthropist Joseph John Gurney (1788–1847), aroused considerable opposition, particularly in the U.S., and another schism resulted among the Orthodox Friends. A new sect, the orthodox conservative Friends, called Wilburites after their leader John Wilbur (1774–1856), was founded to emphasize the strict Quakerism of the 17th century. It is very small today.

The general result of these modifications, both those dealing with doctrine and those pertaining to the relations of Quakers to the world in general, was a new spirit among all the Friends. Most of them abandoned their strange dress and speech and their hostility to such worldly pursuits as the arts and literature. Among members of the society who became prominent in British public and political life was the philanthropist Elizabeth Gurney Fry (1780–1845). Quakers became particularly important as social reformers. They were leaders for the abolition of slavery and began, as early as 1681, a campaign to end corporal punishment for crime. They worked for the education of the poor and for world pacifism.

Although the Quakers have been conscien-



*The Bradford Friends Meetinghouse was built in 1765
It stands in Marshallton, Chester County, Pennsylvania.
Quaker Collection-Haverford College Library*

tious objectors in time of war, the Society of Friends has devoted itself notably to the relief of civilian populations distressed by war. This work has been carried on by agencies of the Friends Service Council in Great Britain and by the American Friends Service Committee in the U.S. The importance of these two organizations was emphasized in 1947, when they were awarded the Nobel Peace Prize.

Numerically, the Friends have always been a relatively small group. In the early 1970's world membership totaled about 200,000, distributed in about thirty countries. The greatest number of Friends is in the U.S. where, according to the latest available statistics, the society had about 1100 congregations with about 120,000 members. The Yearly Meetings in Africa, with about 41,000 members, and in Great Britain and Ireland, with about 23,000 members, are the next largest groups. Other groups are located in Central America, Australia, Canada, and New Zealand. The Friends World Committee for Consultation is the international organization of the society.

Friends in the United States. Friends began to emigrate to the American colonies in the 1660's. They settled particularly in New Jersey, where they purchased land in 1675, and in the Pennsylvania colony, which was granted to William Penn in 1681. By 1684, approximately 7000 Friends had settled in Pennsylvania. By the early 18th century, Quaker meetings were being held in every colony except Connecticut and South Carolina. The Quakers were at first continually persecuted, especially in Massachusetts, but not

in Rhode Island, which had been founded in a spirit of religious toleration (see WILLIAMS, ROGER). Later, they became prominent in colonial life, particularly in Pennsylvania and Rhode Island. During the 18th century the American Friends were pioneers in social reform; they were friends of the Indians, and as early as 1688 some protested officially against slavery in the colonies. By 1787 no member of the society was a slave owner. Many of the Quakers who had emigrated to southern colonies joined the westward migrations into the Northwest Territory because they would not live in a slaveowning society.

The doctrinal conflicts of the 19th century resulted in secessions in five Yearly Meetings. The Hicksites, or liberals, although fewer in number than the Orthodox Friends, formed their own meetings. The second split, over the evangelical movement introduced by Gurney, resulted in the formation of separate groups of Orthodox Friends: progressives, or Gurneyites, and conservatives, or Wilburites. The Gurneyites were particularly numerous among the western Quakers, and by the end of the 19th century they had introduced drastic changes into their Yearly Meetings. In addition to employing paid ministers, using music in the meetings for worship, and following an order of service, some meetings moved in the direction of Fundamentalism (q.v.) in their Protestant theology.

FRIES

Every Yearly Meeting of each group is completely autonomous. In 1902, however, in order to create closer unity in spirit and action, the Orthodox Friends organized the Five Years Meeting of Friends in America. This confederation, which originally met every five years, changed its name, in 1965, to Friends United Meeting and now meets every three years. It serves as a consultative and administrative agency, with headquarters in Richmond, Ind. Four Yearly Meetings in the Gurneyite wing of the Society formed the Evangelical Friends Alliance in 1965. No central offices are maintained by this group, but it publishes the *Evangelical Friend*, and the meetings make an effort to work together.

The liberal Yearly Meetings organized the Friends General Conference in 1900, with offices in Philadelphia. There are nine Yearly Meetings in this group, including several that also belong to Friends United Meeting.

Most of the American groups are also represented in the American Friends Service Committee (A.F.S.C.) founded in 1917, with headquarters in Philadelphia. This organization was formed following World War I to provide relief for distressed areas; activities were expanded to include relief for civilian groups distressed by man made crises and conflicts. The committee was also active during the Spanish Civil War of 1936–39. Following World War II, the A.F.S.C. was very active in Europe. Today the organization is primarily concerned with creating a society in which violence need not exist. The philanthropic activities of the Friends are supported by voluntary contributions from individuals, organizations, and foundations, which in a large number of cases are not connected with the Friends.

The Friends are also notably active in education; Quaker schools are considered among the finest in the U.S. Haverford College, founded in 1833, is the oldest, but others, including Swarthmore, Earlham, and Guilford are also well known. Secondary coeducational boarding schools have made an important contribution since Westtown, in Pennsylvania, was founded in 1799. Many schools have also been established throughout the U.S. by various groups of Friends.

For noteworthy American members of the Society of Friends, see *under* MOTT; WHITTIER, JOHN GREENLEAF; WOOLMAN, JOHN. E.B.B.

FRIES, John (1750?–1818), American insurgent leader, born in Montgomery County, Pa. He fought in the American Revolution and later became an auctioneer. In 1798 a Federal property

tax was voted by Congress in anticipation of a possible war with France. In 1799, after the quota for Pennsylvania had been fixed and Federal officers had begun to collect the tax, Fries led many Pennsylvania Germans in armed rebellion against the assessors and collectors. He and several others were eventually captured when the militia was called out by President John Adams (q.v.). In Philadelphia he was convicted of treason and condemned to death. In 1800, however, he was pardoned by President Adams, who, at about that same time, also issued a general amnesty to all concerned in Fries' Rebellion. **FRIESIAN**, variant spelling of Frisian. See **FRI-SIAN LANGUAGE AND LITERATURE**.

FRIETCHIE, Barbara. See **FRITCHIE, BARBARA**.

FRIGATE BIRD or MAN-OF-WAR BIRD, large ocean bird of the family *Fregatidae*, in the Pelican order, noted for possessing a larger wing span (about 6 to 7 ft.) in proportion to its weight than any other bird. The frigate bird lives on fish which it steals from other birds; it also catches flying fish and snatches dead fish from the surface of the ocean. Only five living species are known. *Fregata magnificens* lives in the Florida Keys and the southern United States. The adult male is glossy black on its back and duller black on its lower parts. During the mating season the male develops a deep red or brilliant orange color on its expansible throat pouch. The female is dull, rusty brown with a white breast and white upper abdomen. The average length of *F. magnificens* is 40 in., of which 17 in. is tail. A slightly smaller but otherwise similar bird, *F. aquila*, is found only on Ascension Island in the Atlantic Ocean; *F. minor* is found in the tropics around the world; *F. andrewsii* is found on several islands in the Indian Ocean; and *F. ariel*, the smallest species of frigate bird, is found in the Atlantic, Pacific, and Indian oceans, in the Southern Hemisphere.

FRIML, (Charles) Rudolf (1879–1972), American composer, born in Prague (now in Czechoslovakia). From 1900 to 1903 he studied at the Prague Conservatory, under the Czech composers Josef Jiránek (1855–1940) and Anton Dvořák (q.v.). Friml became the accompanist for the noted violinist Jan Kubelik (1880–1940), with whom he toured Europe and the United States. After 1906 Friml resided permanently in the U.S. and became a citizen in 1924. He was one of the leading composers of operettas (a total of 33), musical comedies, and revues of his time. Among his works, most of which achieved great popular success, were *The Firefly* (1912); *High Jinks* (1913); *Katinka* (1916); the *Ziegfeld Follies* of 1921, 1923, 1924, and 1925; *Rose Marie* (1923);



A group of frigate birds, *Fregata magnificens*, also known as man-of-war birds.
Allen D. Cruickshank —
National Audubon Society

The Vagabond King (1925); *No Foolin'* (1926); *The Three Musketeers* (1928); *Luana* (1930); and *Annina* (1934). Among his well-known songs are "Rose Marie", "Indian Love Call", "Allah's Holiday", "Only a Rose", "The Firefly", and "Song of the Vagabonds". In addition, Friml composed much music for the piano, piano and violin, and cello and piano; and music for several films. In the late 1960's he gave occasional piano concerts and continued to compose.

FRINGE TREE, name given to trees of the genus *Chionanthus*, belonging to the Olive family Oleaceae. *Chionanthus virginica*, also called snowflower and old-man's-beard, is found along riverbanks in the eastern United States and Texas. It is a large shrub or small tree with numerous snow-white flowers borne in drooping clusters. The petals are long and ragged, giving the appearance of a fringe. The fruit of the fringe tree is an unpalatable, purple, fleshy drupe. The fringe tree is cultivated as a lawn or border shrub. A related Chinese species, *C. retusa*, which has panicles shorter than those of *C. virginica*, is also cultivated in the eastern U.S.

FRISCH, Frank (Francis) (1898–1973), American baseball player, born in New York City, and educated at Fordham University, where he was a noted athlete. He played baseball for Fordham and other amateur teams, and in 1919, without minor-league experience, became a second baseman for the New York (N.Y.) Giants. In 1926 he became second baseman for the Saint Louis (Mo.) Cardinals. Frisch, known as the "Fordham Flash", remained with the Cardinals until 1939, serving part of that period as manager of the team; from 1940 to 1946 he was manager of the Pittsburgh (Pa.) Pirates. In 1947–48 he was a radio broadcaster for the games of the New York (N.Y.) Giants, and in 1948 he joined the Giants again as coach. He managed the Chicago (Ill.) Cubs from 1949 to 1951. During his career

Frisch played in more than 2300 games, had more than 2800 hits, and his lifetime batting average was .316. In 1947 he was elected to the Baseball Hall of Fame; see BASEBALL HALL OF FAME AND MUSEUM, NATIONAL.

FRISCH, Karl von (1886–), Austrian-German zoologist, born in Vienna and educated at the universities of Vienna and Munich. His long teaching career (1911–58) included twenty-nine years at the University of Munich, at which he performed most of his important research with bees, studying their color and taste senses, their language, and their ability to perceive polarized light. He shared the 1973 Nobel Prize in medicine and physiology with two other naturalists, the Austrian Konrad Zacharias Lorenz (q.v.) and the Dutch Niko(laas) Tinbergen (see under TINBERGEN). They were cited for their discoveries in individual and social behavior patterns.

FRISCH, Max (1911–), Swiss humanist, playwright, and novelist, one of the most prominent contemporary German-language writers.

Born May 15, 1911, in Zürich, Switzerland, Frisch completed his studies in German and literature at the University of Zürich in 1933, and then worked as a journalist. His first novel, *Jürg Reinhart*, was published in 1934. He studied architecture between 1936 and 1940 and was a practicing architect when he began his first play, *Santa Cruz*, a romance.

Among his more notable and characteristic plays is *Die chinesische Mauer* (1946; Eng. trans., *The Chinese Wall*, 1961), an experimental farce that mingles ancient with contemporary settings and characters and is addressed to man's self-destructiveness. Next appeared *Als der Krieg zu Ende war* (*When the War Was Over*, 1949) and *Graf Öderland* (1951; Eng.

trans., *Count Oederland*, 1962), both pessimistic and political. Perhaps his best-known plays are *Andorra* (1961), a tragic parable on the effects of prejudice, and the satiric comedy *Biedermann und die Brandstifter* (1958; Eng. trans., *The Fire Raisers*, 1962).

Stiller (1954; Eng. trans., *I'm Not Stiller*, 1958), a novel about an intellectual struggling with his identity, is regarded by some as Frisch's finest work to date. Other novels include *Homo Faber* (1957; Eng. trans., 1959) and *Mein Name sei Gantenbein* (1964; Eng. trans., *A Wilderness of Mirrors*, 1965).

FRISCH, Ragnar (1895–1973), Norwegian economist, born in Oslo, and educated at the University of Oslo. From 1931 to 1965 Frisch was a professor of social economy and statistics and director of the Institute for Social Economy at Oslo. In the 1930's he was a pioneer in the new science of econometrics, the use of mathematical formulas based on statistics in solving economic problems. In 1930, as visiting professor at Yale University, he founded the Econometrics Society, and he was the editor of the society journal *Econometrica* until 1955. For this work Frisch shared the first Alfred Nobel Memorial Prize in economic science, awarded in 1969, with the Dutch economist Jan Tinbergen (see *under* TINBERGEN). See also NOBEL PRIZES.

FRISCHES HAFF (Low Ger., "freshwater bay"), also known as VISTULA LAGOON, large inlet of the Gulf of Danzig, on the Baltic coast of the area formerly known as East Prussia. In 1946, following World War II and the liquidation of the State of Prussia, part of the coastline contiguous to Frisches Haff was ceded to Poland and the remainder was included in the U.S.S.R. Frisches Haff is 52 mi. long from S.W. to N.E.; it varies from 4 to 12 mi. in width, from 10 to 16 ft. in depth, and has an area of 332 sq.mi.

FRISIAN ISLANDS, group of islands in the North Sea, 3 to 20 mi. off the coasts of the Netherlands and West Germany, and extending from the Waddenzee to the S. part of the Danish peninsula of Jutland. The islands are separated from the mainland by shallows, and mark the outer edge of the former continental coastline. The German and Netherlands governments have erected dikes and artificial embankments to protect the islands against incursions of the sea, but despite these efforts, parts of the Frisian Islands are slowly disappearing because of the constant marine erosion. Many Frisian legends and folk songs tell of submerged villages. The chief occupations of the Frisians are fishing, raising sheep and cattle, and farming, mainly potatoes. See FRISIAN LANGUAGE AND LITERATURE.

The West Frisian Islands, belonging to the Netherlands, are Texel, Terschelling, and Vlieland, administered by North Holland Province; Ameland and Schiermonnikoog, part of Friesland Province; and Boschplaat and Rottumeroog, included in Groningen Province. The islands in the group vary in size from the small uninhabited islands of Groningen Province to Texel (area, 64 sq.mi.; pop., 1972, 11,681). The N. end of Texel is called Eijerland or "island of eggs" because of the large number of eggs laid by seabirds that are found there; part of the island is a bird sanctuary. It was joined to Texel in 1630 by a sand dike and cannot be distinguished from the main island. The island of Ameland is joined to the mainland by a stone dike built in 1873. The history of the islands dates from the 8th and 9th centuries, when the larger ones were independent fiefs.

The East Frisian Islands belong to West Germany and include Borkum, Baltrum, Langeoog, Norderney, Spiekeroog, Memmert, Juist, and Wangerooge. The islands in this group range in area from about 2 to 12½ sq.mi. Some of these islands are virtually uninhabited; the most populated island is Norderney (pop., 1971 est., 7165). Several of the islands have lighthouses and lifeboat stations, and the larger ones are summer resorts. The present islands of Borkum and Juist are fragments of the original island of Borkum (est. area, 380 sq.mi.), which was broken up by the sea in the late 12th century.

The North Frisian Islands, with the exception of the Danish islands of Fanø and Rømø, also belong to West Germany. In the 13th century the North Frisians had an estimated area of about 1050 sq.mi., but constant erosion had caused the total area to shrink to 105 sq.mi. by 1850. The North Frisian group includes Sylt, Nordstrand, Pellworm, Föhr, and Helgoland (q.v.), as well as Fanø and Rømø. Several of the smaller islands in the group rise only a few feet above sea level; others are close to 40 sq.mi. in area. Some of the islands are uninhabited; the population of Rømø (1971 est.) was 1000.

FRISIAN LANGUAGE AND LITERATURE, ancient language, once the predominant tongue along the coast of the North Sea and on the coast islands from the Scheldt to the Ems rivers; it is a dialect of Low German and a member of the Teutonic branch of the Indo-European languages (q.v.), closely related to English. Since about the 16th century, when parts of the Frisian territory were incorporated into the Netherlands, Frisian has been supplanted by the Dutch and Plattdeutsch (Low German) languages. It is still, however, an official language in the Dutch

province of Friesland, and various dialects are spoken on the Frisian Islands (q.v.).

Although the Frisians are mentioned in Frankish writings as early as the 6th century A.D., no document in Frisian can be dated earlier than the 13th century. The oldest Frisian writings extant are collections of laws, old Germanic sagas, legal documents, and a collection of verses. New West Frisian literature dates from the 17th century; the first notable work in that language was a comic dialogue, *Wouter en Tialle* ("Wouter and Tialle", 1609). The two greatest figures in Frisian literature are the poet Gijsbert Japiks (1603–66) and Jan Althuysen (1715–63). Interest in Frisian diminished in the late 18th century, but revived in the early 20th century. **FRIETCHIE, Barbara** or **FRIETCHIE, Barbara**, legendary American heroine who reputedly defied the Confederate troops under General Thomas Jonathan ("Stonewall") Jackson (q.v.) as they advanced through Frederick, Md., by waving the Stars and Stripes (see FLAG OF THE UNITED STATES) from an upper window of her home. This story, now considered apocryphal, is the subject of a popular poem, "Barbara Frietchie" (1864) by John Greenleaf Whittier (q.v.), and a play, *Barbara Frietchie* (1899) by Clyde Fitch (q.v.).

FRITILLARY, common name for lilies of the genus *Fritillaria*, found in northern temperate and subarctic regions. The showiest species, *F. imperialis*, commonly known as the crown imperial, is native to central Asia. It has large clusters of yellow, orange, or scarlet bell-shaped flowers, borne on a stem 3 to 4 ft. tall. The common fritillary of England, *F. meleagris*, also called the checkered lily, usually has a single flesh-colored, dark-spotted flower. Native American species, which are found on the Pacific coast, include the golden-flowered *F. pudica*, the orange and scarlet-flowered *F. recurva*, the purple or brown *F. lanceolata* (mission bells), and the purplish *F. parviflora*. *Fritillaria camtschatcensis*, sometimes called the black lily, grows from California to Alaska and in Siberia.

FRIULI-VENEZIA GIULIA, region of Italy, the most N.E. section of the country, bordered on the N. by the Carnic Alps and Austria, on the N.E. and E. by Yugoslavia, on the S.E. and E. by the Gulf of Venice in the Adriatic Sea, and on the W. by the Italian region of Venetia. The region is divided into Gorizia, Trieste, and Udine provinces. The N. portion of the region is mountainous, with some elevations exceeding 9000 ft.; it receives the highest rainfall in Italy. This area, the Friuli section, is known for ham and dairy products. Other industries include livestock raising, lead and zinc mining, and some

lumbering. The Tagliamento R. runs in a N.-S. direction through the center of the region into the Adriatic Sea. In the S. a low fertile coastal plain supports subsistence agriculture. The chief products are wheat, corn and other vegetables, and fruits, particularly grapes for wine. Along the coast fishing is important. Tobacco is produced in the S.E. around Trieste (q.v.), the regional capital and one of Italy's chief ports. Both Trieste and Monfalcone contain shipyards. Other leading cities are Udine and Gorizia. Industries include the manufacture of textiles, chemicals, cutlery, and machinery.

In the 2nd century B.C. the area that is now Friuli-Venezia Giulia was occupied by the Romans, who called it the Julian region. Later it came under the control of the Byzantines, the Venetians, and the Hapsburgs. In the 18th century the Hapsburgs made Trieste a free port. In 1816 Udine, or the W. portion of Friuli, became part of the kingdom of Italy; E. Friuli was joined to Italy after World War I, becoming part of the province of Venezia Giulia. After World War II Udine Province and Gorizia, a portion of Venezia Giulia, were combined to form the modern region of Friuli-Venezia Giulia. In 1954 the N. half of the former Free Territory of Trieste, including the city of Trieste, was assigned to Italy by the United Nations and incorporated into the region of Friuli-Venezia Giulia; see also TRIESTE, FREE TERRITORY OF. In 1963 Friuli-Venezia Giulia was established as one of the five autonomous regions of Italy (q.v.).

Area, 3031 sq.mi.; Pop. (1971) 1,209,812.

FROBISHER, Sir Martin (1535?–94), English navigator and explorer, born in Altofts, Yorkshire. He was apprenticed as a cabin boy in 1544. By 1565 he had risen to the rank of captain, and in 1576 he was placed in command of an expedition to the New World; this expedition was the first attempt by an Englishman to search for a Northwest Passage (q.v.) to India. On June 7, 1576, he set sail with three small ships, the *Gabriel*, the *Michael*, and a pinnace that was lost in a storm; the *Michael* deserted soon afterward and the *Gabriel* continued alone, sighting the mouth of what is now known as Frobisher Bay (q.v.) a little more than a month after starting out on the voyage. On his return to England Frobisher brought back a few pieces of "black earth", which were rumored to be gold, and in 1577 he returned to Canada with another fleet outfitted by Elizabeth I (q.v.), Queen of England. Both this expedition and a subsequent voyage were unsuccessful in finding valuable ore and establishing colonies, but Frobisher continued in the favor of the queen. In 1585, as

FROBISHER BAY

vice-admiral on the *Primrose*, he participated in an expedition to the West Indies led by the English seaman and adventurer Sir Francis Drake (q.v.). In 1588 Frobisher was knighted for his role in the defeat of the Spanish Armada (see ARMADA). In 1591, he settled in Yorkshire, but he soon tired of country life, and in 1592 commanded a fleet outfitted by Sir Walter Raleigh (q.v.) to harry Spanish merchant ships bringing gold from Panama. In November, 1594, engaged in the relief of Brest, France, against Spanish forces, Frobisher was mortally wounded at Fort Crozon near Brest and died in Plymouth, England.

FROBISHER BAY, inlet of the North Atlantic Ocean, cutting deeply into s.e. Baffin Island, Canada. It is about 240 km (149 mi.) long and up to 65 km (40 mi.) wide and has exceptionally high tides. The town of Frobisher Bay is near the head of the bay. Discovered by Sir Martin Frobisher (q.v.) in 1576, the bay is named for him. **FRÖDING, Gustaf** (1860–1911), Swedish poet, born in Värmland County, and educated at the University of Uppsala. After leaving the university he worked for some time as a journalist. In his first collection of poetry, *Guitarr och Dragharmonika* (1891; Eng. trans., *Guitar and Concertina*, 1925), which contained many droll poems about provincial life in Värmland, he made frequent use of the Värmland dialect and often captured the rhythm of its folk songs and dances. His first collection was followed by *Nya Dikter* (1894; Eng. trans., *New Poems*, 1925), *Stänk och Flikar* ("Splashes and Rags", 1896), *Nytt och Gammalt* ("New and Old", 1897), and *Gralstänk* ("Grail Stank", 1898).

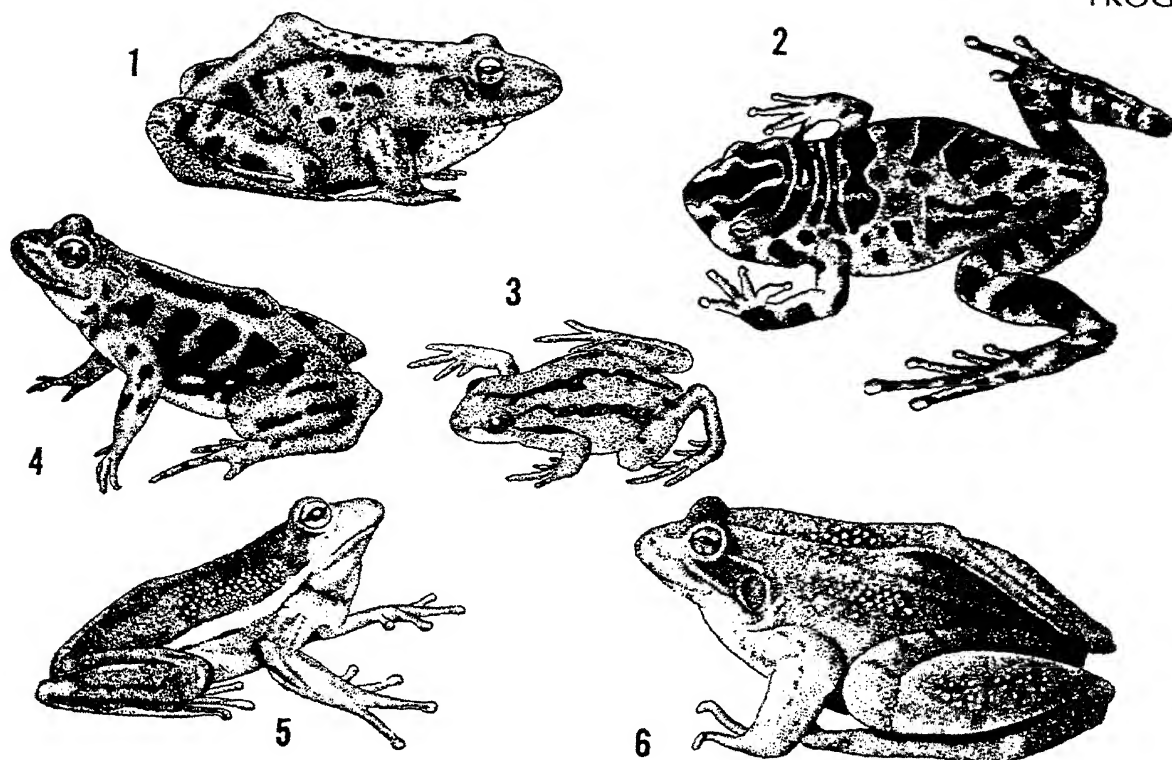
Fröding suffered several nervous breakdowns early in his career. After 1894, although he was either insane or on the verge of insanity, he wrote his finest work. The masterful use of language, the lyricism, and the irony which he had displayed even before his illness were enriched by a more somber tone and a new prophetic quality. Fröding's later collections of poetry deal with profound religious and moral questions and are pervaded by his belief that all things on earth serve a divine purpose.

From 1898 to 1905 Fröding was confined to a mental hospital in Uppsala, but he continued to write. Fröding's work lent vigor to a late-19th-century renaissance of Swedish poetry and exerted a strong influence on later Swedish poets. **FROEBEL, Friedrich** or **FRÖBEL, Friedrich** (1782–1852), German educator, the originator of the kindergarten, born in Oberweissbach. He was largely self-educated, studying for only a few months at the University of Jena. Froebel 388

tried a number of vocations, including forestry, surveying, estate managing, and architecture, before discovering his true vocation, teaching. He became an instructor at the Frankfurt Model School in Frankfurt-am-Main, and from 1808 to 1810 he worked and studied with the noted Swiss educational reformer Johann Heinrich Pestalozzi (q.v.) at Yverdon, Switzerland. Froebel's teaching career was interrupted from 1813 to 1815 by service in the Prussian army and by work as an assistant in the Mineralogical Museum of Berlin University. It was not until 1816 that he began to devote himself entirely to his lifework. In that year he founded at Griesheim a school called the Universal German Education Institute, and in 1817 he moved the school to Keilhau near Rudolstadt. At the institute, Froebel developed ideas for the education of children of preschool age, the years three to seven. These ideas culminated in his establishing at Blankenburg, Thuringia, in 1837, the first institution exclusively for the education of such children; for this school he coined the term "Kindergarten" (children's garden). In spite of interest in his work by progressive educators, his ideas, which stressed the natural and spontaneous growth of a child through action or play, were too novel to be readily accepted by the public, and for a time he found it financially difficult to carry on his school. In addition, Froebel was suspected of sharing the radical political and social views of his nephew Julius Froebel (1805–93), a professor at Zürich, and in 1851 the Prussian government banned all kindergartens in Prussia; the ban was not removed until 1860. In spite of all handicaps, however, Froebel established kindergartens throughout Germany. He lived and worked in Marienthal from 1850 until his death. Froebel is considered one of the greatest contributors of the 19th century to the science of education. The institution of the kindergarten created by him has spread over the entire world. Among the principal writings of Froebel are *Die Menschengenerziehung* (1826; Eng. trans., *The Education of Man*, 1885) and *Mutter-und Kose-lieder* (1884; Eng. trans., *Mother's Songs, Games and Stories*, 1920).

See also CHILD PSYCHOLOGY; KINDERGARTEN; PRESCHOOL EDUCATION.

FROG, amphibian (see AMPHIBIA) of the order Salientia (formerly Anura), usually characterized by absence of tail in the adult, smooth skin, external eardrums situated behind the eyes, long hind legs, and, in most species partially or completely webbed feet. The frog's skeleton is characterized by a meeting and joining of the two halves of the shoulder girdle in a line along the



Categories of frogs: 1) Gopher frog 2) Barking frog 3) Swamp cricket frog 4) Mink frog 5) Green tree frog 6) Oregon red-legged frog

middle of the underside. During the course of its growth, a frog characteristically goes through a true metamorphosis (q.v.), starting with a fish-like larval stage and ending with the adult frog stage.

The eggs hatch in water into short-bodied larvae during early spring or summer. At this stage they are called tadpoles, and have gills and a tail. The tadpole feeds on algae and other vegetation; as it matures, the tail is absorbed, the gills disappear, lungs develop, the limbs appear as buds and grow to their final size, and the adult emerges from the water onto the land.

Various frog species frequent a variety of places, but most prefer a moist area. Although they are air-breathers, frogs can stay under water for long periods. A frog absorbs water through the skin; certain species absorb and store large quantities. Some frogs are adapted for tree living; see TREE FROG. Others are permanently aquatic and have fully webbed toes; still others spend most of their lives in underground burrows, coming up only to feed or to breed. The frog hibernates after burrowing deep in mud. Some kinds, such as Australian frogs, estivate (see HIBERNATION) after burying themselves in sand and clay.

Frogs subsist principally on insects, worms, spiders, and centipedes. Capturing the food is facilitated by the frog's tongue, which is covered with a sticky substance, and which is at-

tached at its base to the front of the mouth instead of the rear, leaving the other end of the organ free to dart out and seize its prey. Aquatic frogs sometimes eat other frogs, tadpoles, and small fish. The bullfrog (q.v.) eats objects as large as mice or newborn water snakes. Occasionally a frog, like some snakes and birds, seizes living food too large to swallow all at once and will leave the prey sticking partly out of its mouth, ingesting it gradually or even choking on it.

Classification. The scientific classification of frogs is complex, having changed over the centuries. The frog (Gr. *batrachus*) originally gave its name to all amphibia which were known as "batrachia". Amphibia replaced batrachia as a term for the class, while batrachia came to designate an order of the class. The latter term, however, was replaced first by "Anura" and later by "Salientia", the current name for the order.

Most herpetologists believe the order Salientia to be subdivided into sixteen families, based primarily on skeleton and tooth differences. Toads belong to the family Bufonidae, a nearly cosmopolitan family native to all continents except Australia and Antarctica. One large species, the marine toad, *Bufo marinus*, is native to trop-

FROG

ical America, but has been introduced successfully into many warm areas of the world, including Australia, to help control insect pests. It secretes, however, a substance poisonous to small animals.

Another large and nearly cosmopolitan family is the Ranidae, comprising the true frogs, many species of which are well known. This family includes the largest of all frogs, the African giant frog, *Rana goliath*, which grows as long as 26 in. and weighs as much as 10 lb. The largest true frog in America is the bullfrog, *R. catesbeiana*, which may weight 20 oz. and have a total length of 18 in. from the snout to the tip of the toes. One of the commonest North American species is the leopard frog, *R. pipiens*, which is easily recognized by the numerous black, often light-edged, spots on the back and legs. Another American species, the wood frog, *R. sylvatica*, is small and reddish brown, with two black bands on the head giving it the appearance of a mask. Unlike most other true frogs, the wood frog wanders considerable distances away from water. The green frog, *R. clamitans*, is another common species in America; it has a wide color range, some being predominantly brown. The pickerel frog, *R. palustris*, looks much like the leopard frog, but has squarish, dark marks arranged in two defined rows down the back. This frog inhabits cool, woodland streams or bogs. Two well-known European frogs of this group are the common frog, *R. temporaria*, which resembles the American wood frog, and the edible frog, *R. esculenta*.

A large and interesting family of frogs with world-wide distribution is the Hylidae. This family includes the tree frogs, which have expanded, adhesive disks at the ends of the toes, permitting them to climb the smooth surfaces of trees. Some members of the Asian family Rhacophoridae have even more specialized structures for arboreal life; their feet are webbed with fan-like structures which enable them to jump safely to the ground from considerable heights; they are sometimes known as flying frogs, although they do not actually fly. One of the most unusual frogs is *Astylosternus robustus*, called hairy frog, for the hairlike dermal projections that develop on the side of the body and legs of the male during the breeding season.

The frog aids man in many ways. It controls insect pests in the woods, farm, and garden, and several species have been introduced to various parts of the world to aid man in his struggle with undesirable insects. From earliest times the frog has been widely used as food. Many efforts have been made to rear frogs for the market, but

all frogs eaten today are taken from their natural habitat. The frog is an important experimental animal in research and medical laboratories, the males of many species being used in present-day diagnostic tests for human pregnancy.

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FROGMOUTH, common name for any of twelve species of crow-sized, wide-mouthed birds which comprise the Podargidae family of the Goatsucker order, Caprimulgiformes. They are found in southern India, Indonesia, the Philippines, and Australia. The frogmouth is nocturnal and feeds on large insects. During the day it sits quietly, its eyes closed, so that it resembles a tree stump.

FROHMAN, name of two American theatrical managers and producers who were brothers.

Daniel Frohman (1851–1940), born in Sandusky, Ohio. He entered the theatrical business about 1871 as a road-company manager. Starting his career as theater manager in 1879, he supervised various theaters in New York City, including the Madison Square Theater, the Fifth Avenue Theater, and the Lyceum Theater (1885). At the Lyceum he organized the Daniel Frohman Stock Company, and presented the popular team of E. H. Sothern (see under SOTHERN) and Julia Marlowe (q.v.) in Shakespearean productions (1905–06). Frohman was often involved in theatrical enterprises with his brother Charles, and was a member of the "theatrical trust", organized by the latter.

Charles Frohman (1860–1915), born in Sandusky, Ohio. His first theatrical experience was as a box-office clerk in a theater in Brooklyn, N.Y.; later he became a road-company manager. His first successful production was *Shenandoah* by the American playwright Bronson Crocker Howard (q.v.) in 1889. The following year he assembled the Charles Frohman Stock Company at the Empire Theatre, New York City, which included the playwright David Belasco (q.v.) as stage manager and had among its notable members the actors William Faversham (1868–1940), Henry John Miller (1860–1926), and James Keteltas Hackett (1869–1926) and the actress Henrietta Crosman (1870–1944). In 1895–96 Frohman organized the syndicate, sometimes known as the "theatrical trust", that owned or controlled a large number of theaters in the United States. Among the actors and actresses who were at one time under his management were John Drew (see under DREW), Ethel Barrymore (see under BARRYMORE), Otis Skinner (see under SKINNER), Maude Adams (q.v.), Billie Burke (1886–1970), Margaret Mary Anglin (1876–1958), and May Robson (1865–1942). He produced the

plays of many of the leading dramatists of the day, including several by James Matthew Barrie in London (1903–08) and plays by John Galsworthy, George Bernard Shaw, and Harley Granville-Barker (qq.v.). Frohman died in the sinking of the liner *Lusitania* (q.v.) by German torpedoes during World War I.

FROISSART, Jean (1333?–1410?), French chronicler, born in Valenciennes. In 1361 he went to England, where he was appointed secretary to Philippa, Queen Consort of England (1314?–69), the wife of King Edward III (q.v.). Froissart visited Scotland in 1365, later journeying to Brussels and traveling widely in France and Italy. Throughout his travels he devoted himself to the gathering of information regarding wars and other contemporary historical events. About 1372 he entered the Church and was appointed priest of the village of Lestines in the diocese of Liège.

During the next twelve years he composed a verse romance entitled *Méliador* and worked on the *Chronique de France, d'Angleterre, d'Écosse et d'Espagne*, which was translated by the English diplomat and man of letters John Bouchier, 2nd Baron Berners (1467–1533) as *Chronicle of France, England, Scotland, and Spain* (1523–25). Resuming his travels about 1386, Froissart visited England and many parts of the Continent, continuing to expand the *Chronicle*. The death of Richard II (q.v.), King of England, is the last notable event recorded in the work.

In the *Chronicle*, Froissart described many of the significant events of the last three quarters of the 14th century. The work, however, cannot be considered a true history according to modern standards of objectivity, because Froissart was imbued with the ideals of chivalry and therefore concerned himself exclusively with the activities of the nobility and the military.

FROMENTIN, Eugène (1820–76), French painter and author, born in La Rochelle. He was influenced by the paintings of Jean Baptiste Camille Corot and Ferdinand Victor Eugène Delacroix (qq.v.). Fromentin specialized in painting pictures of north African, particularly Algerian life, which are characterized by representational fidelity and vivid color. Among his paintings are "Arab Bivouac at Sunrise" (private collection, Paris), "Encampment in the Atlas Mountains" (Walters Art Gallery, Baltimore), and "Arabs Crossing a Ford" (1873, Metropolitan Museum of Art, New York City). His writings include *Un Été dans le Sahara* ("A Summer in the Sahara", 1856) and *Une Année dans le Sahel* ("A Year in Northern Algeria", 1858), travel books; *Domini-que* (1862), a novel; and *Maîtres d'Autrefois*

(1876; Eng. trans., *Masters of Past Time*, 1913), about Flemish and Dutch painting.

FROMM, Erich (1900–), American psychoanalyst, born in Frankfurt-am-Main, Germany, and educated at the universities of Heidelberg and Munich and at the Psychoanalytic Institute in Berlin. From 1929 to 1932 he lectured on so-



Erich Fromm

Harper & Row

cial psychology at the University of Frankfurt. He emigrated to the United States in 1934 and subsequently became an American citizen. Since 1934 he has been associated with many universities and institutions, among them Columbia University, Bennington College, Michigan State University, the William Alanson White Institute of Psychiatry in New York City, the National Autonomous University of Mexico, and New York University.

Fromm is recognized as an important leader of contemporary psychoanalytic thought; see **PSYCHOANALYSIS**. His main contribution is the application of psychoanalytic theory to social and cultural problems. According to his views, specific personality types are related to specific socioeconomic patterns. To Fromm man is a product of his culture; thus he breaks away from biologically-oriented theories. He also feels that attempts should be made to create harmony between the drives of the individual and the society in which the individual lives.

His works include *Escape from Freedom* (1941), *Man for Himself* (1947), *The Forgotten Language* (1951), *Sane Society* (1955), *The Art of Loving* (1956), *Sigmund Freud's Mission* (1956), *Beyond the Chains of Illusion* (1962), *The Dogma of Christ* (1962), *The Heart of Man*

FRONDE

(1964), *You Shall Be as Gods* (1966), and *The Anatomy of Human Destructiveness* (1973).

FRONDE, series of revolts against the French government between 1648 and 1653, during the regency of Louis XIV (q.v.), King of France. Begun as a protest by the middle classes and the French parliament against the heavy taxation policies of the French statesman Cardinal Jules Mazarin (q.v.), the Fronde evolved into armed insurrection. Order was restored, but a second phase began with a struggle for power by the French nobility against the crown. Their unsuccessful venture marked the last insurrection of French nobles against the monarchy and a strengthening of royal power. *See also* FRANCE: *History; Mazarin and the Regency of Louis XIV.*

FRONT. *See* METEOROLOGY: *Air Masses and Fronts.*

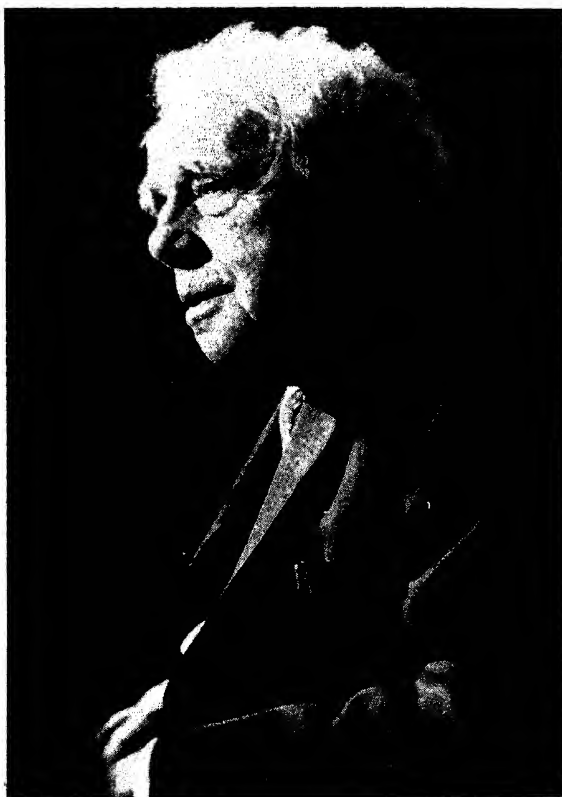
FRONTENAC, Comte de Palluau et de, Louis de Buade (1620–98), French soldier and colonial governor of New France (Canada). Between 1635 and 1672 he was intermittently engaged in military service in the Low Countries and in Italy. He was appointed governor of the French possessions in North America in 1672. In the first years of his administration he attempted to give the people of Québec greater political freedom by establishing a municipal government of three estates—clergy, nobility, and people. This measure ran counter to the French policy of strict royal autocracy; consequently, the powers of the sovereign council were extended and the office of intendant was reinstated to limit the authority of the governor. Frontenac subsequently disagreed with the intendant, who claimed precedence, and with the clergy, who tried to subordinate the state to the Church. Despite the restrictions placed on him, the governor was able to open additional North American territory to France by encouraging the explorations of Louis Joliet, Jacques Marquette, and Robert Cavalier Sieur de La Salle (qq.v.), and by establishing forts and trading posts in the new areas. He was notably skilled and tactful in his relations with the Indians and managed to maintain peace and amity with the powerful Iroquois. In 1682 strife between Frontenac and the intendant and between the governor and the sovereign council, which continually supported the clergy, caused both the intendant and Frontenac to be recalled to France. In 1689, however, when the Iroquois were menacing the inhabitants of New France, Frontenac, then aged sixty-nine, was again sent to North America. He was able to subdue the Indians and successfully governed until his death. *See* CANADA: *History.*

FROST, minute ice crystals that form on surfaces at or near ground level. The crystals form when atmospheric conditions are suitable for the condensation of moisture as dew, but the temperature of the ground and nearby surfaces has cooled to 32° F., the freezing point of water. The water vapor in the air does not condense as a liquid but passes directly from the gaseous to the solid state. Formations of long or needle-shaped ice crystals are called hoarfrost.

FROST, Robert Lee (1874–1963), American poet, born in San Francisco, Calif., and educated at Dartmouth College and Harvard University. In 1885 his father died and his mother moved with the family to Lawrence, Mass. After graduation from high school, Frost sporadically attended college and earned his living by working variously as a bobbin boy in a woolen mill, a shoemaker, a country schoolteacher, the editor of a rural newspaper, and a farmer. Throughout this period he also wrote poetry, but he had little success in having his poems published. In 1912 Frost sold his farm, gave up a teaching post at the New Hampshire State Normal School, and went to live in England. There he met such established British poets as Edward Thomas (1878–1917), Rupert Brooke, and Lascelles Aber-

Robert Frost

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crombie (q.v.), who became his friends and did much to aid his literary career. With their help, Frost published his first two volumes of poetry, a group of lyrics entitled *A Boy's Will* (1913) and a series of dramatic monologues called *North of Boston* (1914). These works won him immediate recognition, and in 1915 Frost returned to the United States to find that his fame had preceded him. Thereafter he continued to write poetry with increasing success, while living on farms in Vermont and New Hampshire and teaching literature at Amherst College, the University of Michigan, Harvard University, and Dartmouth College. Among the volumes of poetry he produced are *Mountain Interval* (1916), *West-Running Brook* (1928), *A Further Range* (1936), *A Masque of Reason* (1945), and *In the Clearing* (1962).

Frost is one of the major American poets of the 20th century. He was awarded the Pulitzer Prize for poetry four times (1924, 1931, 1937, 1943), and in 1961, at the inauguration of President John F. Kennedy (q.v.), Frost became the first poet invited to read a poem at a Presidential inauguration. His poetry is based mainly upon the life and scenery of rural New England, and the language of his verse reflects the compact idiom of that region. Although he concentrates on ordinary subject matter, his emotional range is wide and deep, and he is capable of shifting in the same poem from a tone of humorous banter to the passionate expression of tragic experience. The underlying philosophy of Frost's poetry is rooted in traditional New England individualism, and his work shows his strong sympathy for the values of early American liberalism.

FROSTBITE, injury to the skin and sometimes the deeper tissues of the body due to freezing or formation of ice crystals in the tissue cells. Frostbite usually develops when the air temperature is below 10° F., but may occur at a temperature nearer the freezing point (32° F.) when other factors such as high winds, dampness, or general chilling of the body are present. The onset of frostbite causes little discomfort and may not be noticed by the victim because the cold has an anesthetic effect on the tissues.

Frostbite develops in three stages: a reddening of the skin, formation of blisters, and finally death of some of the skin cells and the underlying tissues. Clots often form in the blood vessels. Mild cases of frostbite often result in chilblain; more severe cases may result in a dangerous gangrene (q.v.). Free circulation of the blood inhibits the onset of frostbite.

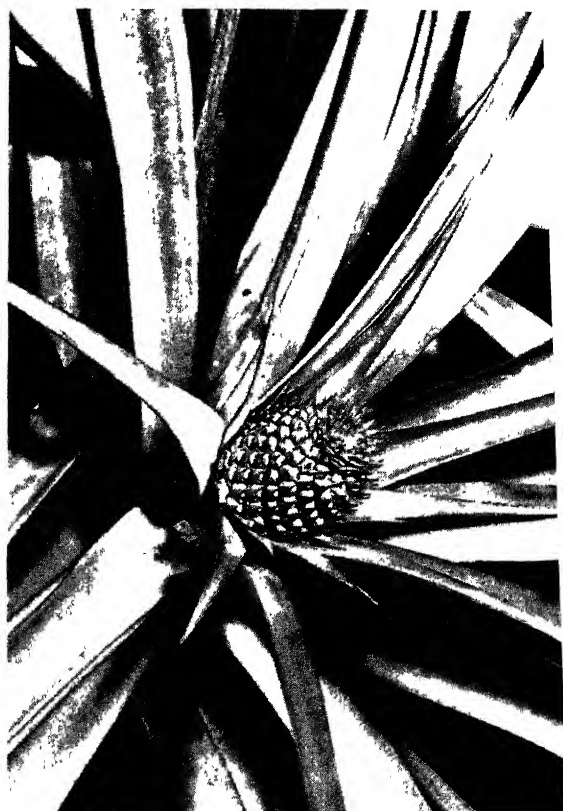
The parts of the body most often affected are

the hands, feet (especially the heels and toes), ears, cheeks, chin, and nose. The first aid treatment for frostbite, which is recommended by the American Red Cross, is the immediate application of warmth to the injured parts; if possible the affected areas should be soaked in warm water. Vigorous massage should be avoided as it would cause further harm to the damaged tissues. Heparin (q.v.), or some other agent that prevents clotting, is administered in severe cases. See also **FIRST AID: Frostbite**.

FROUDE, James Anthony (1818–94), British historian, born in Dartington, Devonshire, England, and educated at Westminster School, London, and Oriel College, University of Oxford. He was elected a fellow of Exeter College in 1842, and two or three years later was ordained a deacon. After meeting the Scottish writer Thomas Carlyle (see under **CARLYLE**), who strongly influenced him and whose literary executor he later became, Froude's religious views began to change; he subsequently manifested a strong anticlerical attitude which culminated in his withdrawal from the ministry in 1872. In 1892, in recognition of his brilliant historical writings, which, like Carlyle's, emphasized the role of the individual in history, Froude was appointed professor of modern history at Oxford. As literary executor for Carlyle, Froude prepared for publication Carlyle's *Reminiscences* (1881) and *Letters and Memorials of Jane Welsh Carlyle* (1883). Froude was the author of two important biographies of his friend: *Thomas Carlyle, A History of the First Forty Years of His Life* (1882) and *Thomas Carlyle, A History of His Life in London* (1884). His great work, however, is his *History of England from the Fall of Wolsey to the Defeat of the Spanish Armada* (12 vol., 1856–70).

FRUCTOSE, or **LEVULOSE** or **FRUIT SUGAR**, sugar with the formula $C_6H_{12}O_6$. It occurs with glucose (q.v.) in sweet fruits and fruit juices and is formed along with glucose in the inversion of sucrose (q.v.). It is produced in the hydrolysis of various carbohydrates but is best prepared by treating inulin with dilute acid. Fructose is crystallized with difficulty; the crystals melt, that is liquefy, in the range from 102° to 104° C. (216° to 219° F.). It is levorotatory; that is, solutions of fructose rotate the plane of polarization (of polarized light) to the left. Fructose is fermented by yeast to yield alcohol and carbon dioxide. See **SUGAR**; **SUGAR, METABOLISM OF**.

FRUIT, mature ovary in flowering plants, together with all inseparably connected parts of the flower (q.v.). In strict botanical usage, the meaning may be restricted to the ovary alone. Commonly the term fruit is often restricted to



Above, left: The bracts of a banana blossom are rolled back to reveal the flowers, the ovaries of which will develop into tiny green bananas. Below, left: Blueberries, the fruit of a shrub in the Heath family, are true berries, having small seeds dispersed throughout the fleshy mesocarp and endocarp. Above, right: The grape is a berry grown in temperate climates. Grapes are used to make wine, juice, jelly, and raisins; their seeds are used to produce grape-seed oil, and a purple dye is made from the skins of purple grapes. Below, right: The pineapple is a multiple fruit, made up of an entire inflorescence or cluster of flowers.

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succulent, edible fruits of woody plants, to melons, and to such small fruits as strawberries and blueberries. In nature, fruit is normally produced only after fertilization of ovules has taken place, but in many plants, largely cultivated varieties such as seedless citrus fruits, bananas, and cucumbers, fruit matures without fertilization, a process known as parthenocarp. In either case, the maturation of the ovary results in the withering of stigmas and anthers and enlargement of the ovary or ovaries. Ovules within fertilized ovaries develop to produce seeds. In unfertilized varieties, seeds fail to develop, and the ovules remain their original size. The major service performed by fruit is the protection of developing seeds. In many plants, fruit also aids in seed distribution. See SEED.

Structure of Fruit. As the ovary matures, its wall develops to form the pericarp, divided into three layers. The outermost, exocarp, is usually a single epidermal layer. The extent of the middle layer, mesocarp, and the inner layer, endocarp, varies widely, but in any single type of fruit one of the layers may be thick, the others thin. In fleshy fruits the pulpy layer is usually the mesocarp, as in peaches or grapes. The seed or seeds, which lie immediately within the pericarp, in some cases constitute the entire edible portion of the fruit. For example, the hard outer husk of a coconut is the complete pericarp, and the edible part inside, including the "milk", is the seed.

In typical cases, the fruit is confined to the ripened ovary, as in the pea pod; but in apples it includes ovary plus receptacle (ovary stalk), in strawberries it consists of an aggregation of small fruits on a fleshy receptacle, called achenes, and in pineapples it is a development of an entire inflorescence.

Types of Fruit. Classification of fruit involves consideration of several characteristics, the most significant being the number of ovaries included. A simple fruit is a single ovary, developed from the pistil of a single flower, which may be single or compound; an aggregate fruit is composed of many ovaries attached to a single receptacle; a multiple or collective fruit is formed from the coalesced ovaries of an entire inflorescence. Simple fruits are further subdivided into two categories, dry or fleshy. Ovary walls which develop into simple fruits are succulent when young, but as they mature, those of dry fruits lose most of their moisture, while those of fleshy fruits increase in size and moisture capacity. Dry fruits which dehisce, or split, when ripe are called dry dehiscent fruits; those which do not split are called dry indehiscent fruits.

Among the dry dehiscent fruits, the pod or legume characterizes most of the legumes. The shell of the pod is the pericarp, and the beans or peas inside it are the seeds. Dehiscence occurs along the sutures of the two edges, the seeds being attached to the ventral suture. A few leguminous plants have pods which do not dehisce, but break at maturity; a pod of this type is termed a loment. The follicle, found in peony and milkweed, has two sutures like the pod, but opens only along one of them. The capsule, unlike the foregoing, contains more than one seed chamber, or carpel. When capsules split down the middle of each chamber, as in lilies, their dehiscence is loculicidal. When the dehiscence occurs at the lines of fusion of the chambers, as in the azalea, it is septicidal. Poppy capsules open by pores, the dehiscence being poricidal. Capsules of plantain split along a circular horizontal line, so that a "lid" comes off the top; this type of dehiscence is circumscissile. The silique, characteristic of the mustards, is a two-chambered dry fruit which dehisces along two sutures, leaving the exposed seeds clinging to a thin, membranous partition. Most siliques are at least as long as broad; when broader than long, as in delphinium, they are usually called silicles.

Most indehiscent fruits develop a single seed for each ovary. The pericarp of these fruits is so closely invested around the seed that the entire fruit assumes the appearance of a seed. The true grain or caryopsis, characteristic of grasses, is little more than a seed with a thin, membranous pericarp inseparable from it. The achene, such as the "grain" of buckwheat, is sometimes called a "naked seed" because of its thin, separable pericarp. The samara, or key fruit, typified by the fruits of elms, maples, and ashes, has a winglike outgrowth of the ovary wall which aids in dispersal by wind. The typical fruit of the Umbelliferae, the schizocarp, has more than one seed, unlike other dry indehiscent fruits, but the fruit splits into single-seeded portions at maturity. The nut (q.v.), exemplified by acorns, chestnuts, and hazelnuts, is a single-ovary fruit with an extremely hard pericarp.

All fleshy fruits are indehiscent, the pulpy parts remaining attached to the seeds during dispersal. The true berry, typified by the tomato, blueberry, and gooseberry, possesses seeds dispersed throughout the fleshy mesocarp and endocarp. The exocarp is very thin and skinlike. Many fruits, such as strawberries and raspberries, are commonly, but incorrectly, called berries. Two specialized types of berry, the hesperidium and the pepo, include valuable commercial fruits. All citrus fruits, including oranges,

FRUIT

lemons, and grapefruits, are hesperidia, having leathery rinds composed of exocarp and mesocarp, and juicy sections of endocarp. The pepo is the characteristic fruit of the Cucurbitaceae, including cucumbers, pumpkins, melons, and gourds. The outer layer of the pepo is receptacle tissue covering the exocarp; the pulpy portion of the fruit is mostly endocarp and mesocarp. The remaining type of fleshy fruit, the pome, has a pericarp limited to the "core" and the inner fleshy portion of the fruit, as in apples, pears, and quinces. The other portion of the fleshy part of a pome is tissue developed from the receptacle. The drupe is the stone fruit of such plants as plum, cherry, olive, peach, and almond. (The familiar, edible almond, incorrectly called a nut, is the dried stone of a large drupe.) The single seed is surrounded by a stony endocarp; the fleshy portion is mesocarp. A small drupe occurring as part of a larger cluster is usually called a drupelet.

The constituent fruitlets of most aggregate and multiple fruits can be recognized as belonging to the same classification as simple fruits. The aggregate fruitlets of blackberries, raspberries, and dewberries, for example, are drupelets; and those of strawberries are achenes. It is not the fruit, that is, achenes, of strawberries that we eat, but the fleshy receptacle. In the pineapple, on the other hand, the separate fruitlets cannot be classified as types of simple fruit; the multiple fruit is a mass of fused ovaries growing from the central axis of the pineapple.

Food Value. Fruits are eaten raw or cooked, dried, canned, or preserved. Carbohydrates, including starches and sugars, comprise the principal nutritional material. Citrus fruits, tomatoes, and strawberries are primary sources of Vitamin C, and most fruits contain considerable quantities of Vitamin A and Vitamin B. Vitamin content is sharply reduced in storage and shipping of fresh fruits, but is maintained efficiently in frozen fruit (see VITAMIN). The jelly-making quality of many fruits is due to pectin, an important carbohydrate constituent. In general, fruits contain very little protein or fat. Exceptions are avocados, nuts, and olives, which contain large quantities of fat, and grains and legumes which contain considerable protein. Although the edible portions of fruits have a small ash content, fruits supply an important part of the mineral matter necessary in human diet. Such fruits as are dried or evaporated contain much more nutritional material in proportion to their bulk than do fresh fruits, due to concentration by evaporation. For further discussion of the nutritional value of fruit see NUTRITION, HUMAN.

Transportation and Marketing. Marketing quality of fresh fruits depends to a great extent on proper methods of harvesting and shipping. Excepting the few kinds picked green and allowed to ripen in transit, such as bananas and pears, fruit is harvested ripe and sent to market in firm condition. Poor market conditions, in the past, usually resulted from careless handling by packers. Abrasions on fruit are usually attacked by molds and rot fungi. Care in washing and packing, use of oiled-paper wrappers, cellophane, and polyethylene, and use of refrigerator cars in shipping have drastically reduced losses from abrasion and poor preservation.

Although most fruit is consumed in the fresh state, the canning of fruit is an important industry. About 20 percent of the fruit produced in the United States is canned or used for canned fruit juices each year. The distribution of frozen fruit is increasing. Storage holdings of frozen fruit and fruit juices average about 350 million lb. annually. Dried-fruit production is also extensive. See FOOD PRESERVATIONS.

Research. Federal and State agricultural experimental stations are devising methods for production of fruit of better market quality in larger volume. Extensive research in breeding has yielded such fruit varieties as freestone peaches, seedless grapes and citrus fruits, and sweeter varieties of many other fruits. Interspecific as well as intergeneric breeding of certain citrus fruits has resulted in some new types within recent years. For example, the crossing of a lime with a kumquat has produced a limequat; the crossing of a tangerine with a grapefruit, a tangelo. Experiments indicate that plant hormones can be used to hasten maturation of fruits, prevent premature dropping of fruits from trees, and initiate development of fruits without pollination; see HORMONES. Federal agricultural experimental stations are doing extensive research to discover methods of controlling fungus diseases that affect fruit during shipment. Time of harvest is an important factor in fruit production. Fruit picked while underripe never attains good quality and overripe fruit is liable to considerable damage in shipping. The difficulty involved in determining the correct time of harvest has been overcome for pears through the development of pressure testers, which are now used as a fairly accurate gauge for determining maturity. For information on cultivation of fruits, see articles on the various fruits. See also HORTICULTURE; ORCHARD; PLANT BREEDING; PRUNING.

FRUIT FLY, member of various genera of dipterous flies whose larvae feed on fruit and decaying vegetable matter. True fruit flies belong

to the family Trypetidae. Adults of the apple maggot or common apple worm, *Rhagoletis pomonella*, are found in orchards from July to September. The adult female punctures the skin of an apple with her sharp ovipositor and lays one or more eggs in the pulp. The white larvae burrow in the pulp and grow to one quarter of an inch or more. After the apple has fallen, the larvae descend about an inch underground, where they spend the winter and spring as pupae. A similar life cycle occurs in *Rhagoletis cingulata* and *R. fausta*, the cherry maggots, and in *EPOCHRA canadensis*, the currant, and gooseberry worm. The Mediterranean fruit fly, *Ceratitis capitata*, attacks mainly citrus fruits. The so-called fruit fly *Drosophila* (q.v.) with which most modern experiments on genetic mechanism have been performed, is a member of the family Drosophilidae, and thus not a true fruit fly.

FRUIT SUGAR. See FRUCTOSE.

FRUNZE, formerly PISHPEK, city in the Soviet Union, and capital of the Kirghiz S.S.R., in the Chu R. valley, about 400 miles N.E. of Tashkent. Frunze is an agricultural area and a manufacturing center. Farm machinery, metalwork, processed meat and other foodstuffs, and textiles are produced. Several institutions of higher education are in Frunze, including the state university and a branch of the Academy of Sciences of the U.S.S.R. Pop. (1970) 431,000.

FRY, Christopher (1907–), British dramatist, born Christopher Harris in Bristol, England, and educated at Bedford Modern School. He taught school from 1928 to 1931. Thereafter, except for brief periods at various jobs, he made the theater his career, working as an actor, director, and writer. His first major success, *The Lady's Not for Burning* (1948), a tragicomic fantasy in verse, was enthusiastically received in both London and New York City. In the same genre are *Venus Observed* (1950) and *Ring Round the Moon* (1950), a translation of *L'Invitation au Château*, by the French dramatist Jean Anouilh (q.v.); both productions earned critical acclaim. Among Fry's other works are the religious dramas in verse *The Boy with a Cart* (1937), *The First-born* (1947), *Thor, With Angels* (1948), and *A Sleep of Prisoners* (1951); the historical drama *The Dark Is Light Enough* (1954); and *Tiger at the Gates* (1955), *Duel of Angels* (1960), and *Judith* (1962), translations of *La Guerre de Troie*, *n'Aura pas Lieu*, *Pour Lucrèce*, and *Judith* by the French dramatist Jean Giraudoux (q.v.). He also translated Jean Anouilh's drama *L'Alouette* (*The Lark*). He wrote the script for the documentary film *A Queen Is Crowned* (1953) and for *The Bible* (1965).

FUAD I, originally AHMED FUAD PASHA (1868–1936), Sultan of Egypt, (1917–22) and King of Egypt (1922–36), son of Ismail Pasha (q.v.), born in Cairo and educated in Italy. He was a general in the Egyptian army from 1892 until 1895. In 1908 he played an important role in the founding of the Egyptian University (later named Fuad I University) at Giza, serving for a time as its president. Fuad succeeded his brother, Hussein Kamil (1850?–1917), to the sultanate. He became king of Egypt in 1922, on the nominal termination of the British protectorate, and proclaimed an Egyptian constitution the next year. Although opposed to British domination, Fuad was an adversary of the powerful Wafd, or Nationalist, Party, with which he waged a struggle for power throughout his reign, succeeding temporarily in imposing his personal rule on the country by dissolution of Parliament in 1928–29 and from 1930 to 1935. Fuad was succeeded by his son, Faruk I (q.v.). See EGYPT: *History: Protectorate and Kingdom*.

FUCHS, Sir Vivian Ernest (1908–), British geologist and antarctic explorer, born on the Isle of Wight. He received an M.A. degree from the University of Cambridge in 1929 and in the same year served as geologist with the Cambridge East Greenland Expedition. During the 1930's, Fuchs was a geologist with two expeditions engaged in geological and survey work in east Africa. He was commissioned a second lieutenant in the British army in World War II and rose to the rank of major. In November, 1957, Fuchs set out as head of the twelve-man British team of the Commonwealth Trans-Antarctic Expedition, on the first crossing of Antarctica (q.v.), a 2158-mi., 99-day journey from the Weddell Sea, across the South Pole to the Ross Sea. Equipped with snow tractors, the Fuchs party traversed much previously unexplored area of the antarctic land mass and gathered important scientific information. The expedition is considered to be one of the outstanding accomplishments undertaken in connection with the International Geophysical Year (see GEOPHYSICS) and earned Fuchs a knighthood in 1958. With Sir Edmund Hillary (q.v.) Fuchs wrote *The Crossing of Antarctica* (1960).

FUCHSIA, genus of tropical and subtropical plants belonging to the Evening Primrose family Onagraceae, named after the German botanist Leonhard Fuchs (1501–66). Most members of the genus, except a few Australasian species, are found in forests and shady mountain habitats in Central and South America. A few are climbing plants, and others are small trees, but most wild fuchsias are shrubs. Fuchsias cultivated in the

FUEL

United States are grown in greenhouses and as houseplants in colder regions of the country; in the summer, and in milder regions, they may be grown in windowboxes or as bedding plants. The graceful pendulous flowers, often called lady's-eardrops because of their shape, may be solitary or arranged in clusters in leaf axils. Each flower has a colored, funnel-shaped, four-parted calyx and a corolla composed of four petals. In many fuchsias, the color of the calyx contrasts sharply with the color of the corolla. Fuchsia fruits are small berries which, in several species, are edible.



Fuchsia, *Fuchsia magellanica*

New York Botanical Garden

Most cultivated fuchsias are hybrids of wild species or varieties. One of the most attractive cultivated varieties, *F. hybridia*, is probably a hybrid between *F. magellanica* and *F. fulgens*. It has crimson sepals and purple, rose, or white petals. *Fuchsia magellanica* is usually a low shrub with flowers having red sepals and blue petals. Grown outdoors in California, it can reach a height of 20 ft. when trained to grow on walls or trellises.

FUEL, substance or material that reacts chemically with another to produce heat. The term fuel is generally limited to those materials and substances that burn readily in air or oxygen, emitting large quantities of sensible heat. Fuels are used for heating, for the production of

steam for heating and power purposes, for powering internal-combustion engines (see INTERNAL-COMBUSTION ENGINE), and for a direct source of power in jet and rocket propulsion. In cases where a fuel must supply its own oxygen, as in many rockets and torpedoes, an oxidizing agent such as hydrogen peroxide or nitric acid is added to the fuel mixture; see *Modern Rocket Fuels*, below.

Fuels can be classified as solid, liquid, and gaseous. Among the solid fuels are wood, coal, lignite, peat, coke, and such by-products as charcoal, sawdust, coal dust, spent tanbark, and bagasse. Liquid fuels include animal, vegetable, and mineral oils, and gasoline, kerosene, benzene, and alcohol. Gaseous fuels include the gaseous hydrocarbons methane, ethane, ethylene, and acetylene, as well as carbon monoxide and hydrogen. Most gaseous fuels are mixtures of several of these substances, in proportions that depend on the source of the gas (q.v.).

The chemical reactions in the combustion of all ordinary fuels involve the combination of oxygen with the carbon, hydrogen, and sulfur present in the fuels. The end products are carbon dioxide, water, and sulfur dioxide. Other elements present in fuels do not contribute to the combustion but are either driven off in the form of vapor or remain after combustion in the form of ash.

Fuel efficiency or heating value of a fuel is usually measured in terms of the number of B.T.U.'s (see BRITISH THERMAL UNIT) that are produced when a given amount of the fuel is burned under standard conditions. Heating values for solid and liquid fuels are stated in terms of B.T.U.'s per pound, and values for gases in B.T.U.'s per cubic foot. A distinction is sometimes made between higher heating value, the entire heat evolved during combustion, and lower heating value, the net heat evolved, with allowance for the heat lost in the vaporization of the water produced by combustion. Approximate higher heating values of a number of common fuels are given below.

Solid fuels (B.T.U. per lb.): coal 12,000 to 15,000; lignite 6000 to 7400; coke 12,400; dry wood 8500. Liquid fuels: alcohol 11,000; fuel oil 19,000; gasoline 20,750; kerosene 19,800. Gaseous fuels (B.T.U. per cu.ft.): acetylene 1480; blast-furnace gas 93; carbon monoxide 317; coke-oven gas or coal gas about 600; hydrogen 319; natural gas 1050 to 2220; oil gas 516; producer gas 136. See also separate articles on most of the fuels mentioned in this article.

Modern Rocket Fuels. The combustible propellants developed recently to fuel a large vari-

ety of rocket engines are divided into solid and liquid propellants. Solid propellants actually originated in 13th-century China. See **ROCKET: Solid-Propellant Rockets; Liquid-Propellant Rockets**.

The most widely-used solid propellants today are synthetic rubbers that use an oxidizer such as ammonium perchlorate, sometimes made more powerful by the addition of a powdered metal such as aluminum. The liquid-propellant rocket engines, which formerly used gasoline, now either use ethyl alcohol with liquid oxygen or a separate class of liquid fuels known as hypergols, the components of which ignite spontaneously on contact. This propellant usually consists of aniline or a hydrazine as the fuel, with nitric acid as the oxidizer.

Liquid hydrogen has been successfully used by the National Aeronautics and Space Administration (q.v.) to propel the Centaur and Saturn V space-launch vehicles; see **ASTRONAUTICS**.

See also **NUCLEAR ENERGY: NUCLEAR POWER; SOLAR POWER**.

FUEL CELL, device in which the energy of a chemical reaction is converted directly into electricity; see **ELECTROCHEMISTRY**. An electric cell (see **CELL, ELECTRIC**) does the same thing, but a fuel cell has two advantages: the electrolyte in which the conversion of energy occurs remains chemically unchanged and the electrodes are not consumed as they are in an electric cell; and the chemicals are supplied continuously from outside the cell. A fuel cell, therefore, does not run down or require recharging. It will operate for years as long as the chemicals are supplied.

A fuel cell consists of four main parts: the fuel, an oxidizer, two electrodes (one positive,

one negative), and an electrolyte. The fuel enters the cell and is decomposed in the electrolyte into negative and positive ions; see **IONIZATION**. The negative ions (electrons) pass to the negative electrode and the positive ions remain in the electrolyte. From the negative electrode, the electrons pass through the circuit, producing an electric current. The opposite end of the circuit is connected to the positive electrode. There, the electrons react with the oxidizer, forming negatively charged ions. These combine with the positive ions in the electrolyte to form a waste product, thus completing the conversion process.

Fuel cells are theoretically capable of converting chemical into electrical energy with nearly 100 percent efficiency. Because of this, a great deal of research is being conducted to make fuel cells economically practical. Three main types are feasible. In one, the fuel is hydrogen gas; in the second, the fuel is a hydrocarbon (such as methane, gasoline, or natural gas) or a coal product; in the third, the fuel consists of other chemicals or biological reactions. In one experimental fuel cell, for example, decomposing garbage is used as the fuel.

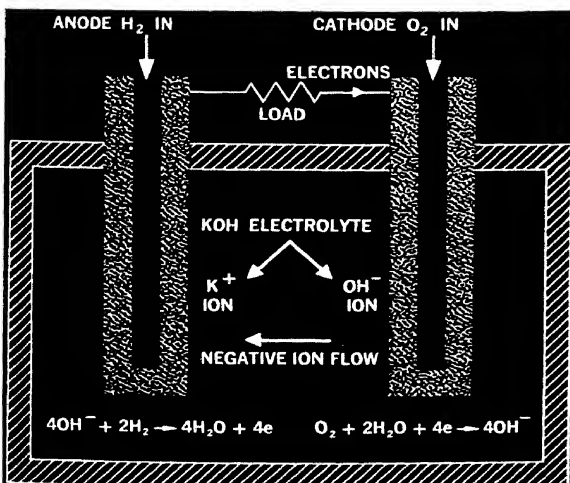
The only practical fuel cell so far developed uses hydrogen as the fuel and oxygen as the oxidizer. This fuel cell is used to supply electrical power to the Gemini and Apollo spacecraft.

FUEL-INJECTION SYSTEM. See **INTERNAL-COMBUSTION ENGINE: Components of Engines**. See also **CARBURETOR**.

FUGITIVE SLAVE LAWS, in United States history, enactments providing for the return of escaped slaves to their owners. During pre-Revolutionary colonial times, the return to their masters of white, Indian, and Negro slaves and indentured laborers who had escaped beyond the borders of the colony of their servitude was governed by the prevailing sentiment of the settlers from the various colonies. Later, it became the subject of official intercolonial regulations and formal agreements.

After the American Revolution, under the Articles of Confederation, the Continental Congress adopted the Northwest Ordinance of 1787, which established the Northwest Territory. The ordinance provided: "There shall be neither slavery nor involuntary servitude in the said territory, otherwise than in the punishment of crimes whereof the party shall have been duly convicted: *Provided, always*, That any person escaping into the same, from whom labor or service is lawfully claimed in any one of the original States, such fugitive may be lawfully reclaimed and conveyed to the person claiming

Diagram of the operation of a hydrogen-oxygen fuel cell. The water produced by an H-O cell can be used for drinking on a spaceship.



FUGITIVE SLAVE LAWS

his or her labor or service aforesaid". See NORTHWEST TERRITORY.

In the same year, the Founding Fathers, assembled in the Constitutional Convention to effect a permanent union of the States, included a "fugitive clause" in the Constitution of the U.S. (q.v.) as a means of compromising the clashing interests of the slaveholding Southern States and the free Northern States. That clause, Article IV, Section 2 (later nullified by the Thirteenth Amendment adopted in 1865), provided: "No person held to service or labor in one State, under the laws thereof, escaping into another, shall, in consequence of any law or regulation therein, be discharged from such service or labor, but shall be delivered up on claim of the party to whom such service or labor may be due". No power, however, was specifically vested in the Federal government to enforce the clause, and each State was therefore, in effect, left free to establish its own policy. The Northern States, in which public sentiment was increasingly hostile to slavery, generally failed to enforce the Constitutional "fugitive clause", and the Southern States thereupon demanded that Congress enact legislation to enforce it.

Act of 1793. In 1793 Congress passed the first Fugitive Slave Law. The essential features were: the oral testimony of a claimant to possession of an alleged fugitive slave was sufficient to establish ownership; following establishment of ownership, the duly constituted authorities were compelled to surrender the fugitive to his owner; and a fine of \$500 was set as the penalty for attempts to conceal the fugitive slave, obstruct his arrest, or, once he was in custody, to attempt to rescue him.

The general result of this law was to widen the breach between the North and the South. Two interacting factors became especially marked after the importation of slaves into the U.S. was discontinued by Constitutional provision after 1808 and the dollar value of slaves consequently increased. The vague terms of the law of 1793 with respect to the establishment of ownership gave rise, particularly in the border States between the South and the North, to the practice of kidnapping Negroes who had been freed or had purchased their freedom, on the ground that they were escaped slaves; slave catching became a lucrative occupation. Despite the kidnappings, harsh treatment made many slaves so desperate that attempts to escape grew in number. The slaves were increasingly aided by the Underground Railroad (q.v.), manned by Northern sympathizers, escaped slaves, and abolitionists (q.v.).

Under pressure from the South, in 1818 Congress amended the law of 1793 to make it still easier to establish ownership of an alleged fugitive slave, by enabling the claimant to make his deposition before a judge in his own State. The revised law also abolished the right of habeas corpus in such cases. The Northern States countered with personal-liberty laws prohibiting their officials from taking part in the apprehension of escaped slaves, forbidding the use of their jails to detain recaptured fugitive slaves, providing for trial of alleged fugitives, and otherwise hampering the attempts of claimants to gain possession of their alleged slaves.

Act of 1850. As the great struggle between North and South became more intense, the South demanded passage of an effective fugitive-slave law as the price of continued union with the Northern States. In 1850, Congress enacted the second Fugitive Slave Law, further amending and supplementing the law of 1793. The most significant feature of this legislation was its provision placing the entire responsibility for enforcement of the law on the Federal government, which explicitly made the government an instrument of the slaveholders. Other provisions of the law made inadmissible any evidence proffered by alleged fugitive slaves in their own behalf; rendered null the application to them of the right of habeas corpus; invested U.S. officials with responsibility for delivery of fugitive slaves to claimants in their home States; imposed severe penalties on U.S. officials from whose custody fugitives escaped or were rescued, and on persons who obstructed the apprehension of fugitives, rescued them from lawful custody, or concealed them; and made guilty of treason bystanders who refused to aid attempts by U.S. officials to apprehend fugitives.

The response of the North was an intensified and multiform opposition to the new law. Personal-liberty laws increased in number and their provisions became so severe and far-reaching as to make extremely hazardous any attempts to apprehend fugitive slaves and to transport them to the South. Secret vigilance committees were organized in Northern cities to thwart the enforcement of the Fugitive Slave Law. Riots attended efforts by U.S. marshals to apply the law. Rescues of fugitive slaves were effected by force, and mass meetings voted thanks to the rescuers. The courts refused to try to convict violators of the law. The Underground Railroad expanded its "lines", and its "operators" ran thousands of slaves to freedom in the Northern States and Canada. Widespread Northern defiance was a factor in Southern secession.

Role of the United States Supreme Court.

One of the most important aspects of the struggle over the Fugitive Slave Law in the decade preceding the outbreak of the American Civil War was the clash of opposing conceptions of the power of the U.S. Supreme Court to decide the constitutionality of legislation which that struggle involved. Of the numerous cases to which the Fugitive Slave Law gave rise, those that reached the Supreme Court were decided in language categorically affirming the constitutionality of the law; see DRED SCOTT CASE. Among these cases was that of Sherman M. Booth of Milwaukee, an abolitionist editor, arrested in 1854 on a charge of having violated the Fugitive Slave Law by instigating a rescue from the lawful custody of a U.S. commissioner of an escaped slave. Booth had been freed on a writ of habeas corpus issued by a Wisconsin State court, and had then been indicted in the Federal District Court of appropriate jurisdiction and convicted but had again been released on a writ of habeas corpus issued by the Supreme Court of Wisconsin. In issuing the writ, the State Supreme Court had declared the Fugitive Slave Law of 1850 unconstitutional, thus placing itself in direct opposition to the U.S. Supreme Court.

The U.S. Supreme Court issued a writ of error to be served on the Wisconsin Supreme Court, and in 1858 reversed the State court. The State court then refused to recognize either the writ of error issued by the U.S. Supreme Court or its reversal of the decision of the Wisconsin court. Both houses of the Wisconsin State legislature passed resolutions in support of the State court, and these resolutions were approved by the governor of the State. In 1859 Wisconsin threatened to secede from the Union if the mandates of the U.S. Supreme Court were executed and the Fugitive Slave Law were enforced in the State. The outbreak of the Civil War two years later terminated the conflict between the Federal and State supreme courts, and eventually the exclusive right of the U.S. Supreme Court to decide on the constitutionality of legislation was established.

Before the Civil War, both the Free-Soil Party and its successor the Republican Party (qq.v.) advocated repeal of the Fugitive Slave Law. The election of Abraham Lincoln (q.v.) as President in 1860 was interpreted by the South as portending an early repeal of the law. The Fugitive Slave Law was repealed during the Civil War, in 1864. See CIVIL WAR, AMERICAN.

FUGUE (Lat. *fuga*, "flight"), most highly developed form of imitative contrapuntal music (see COUNTERPOINT). The most important stylistic fea-

ture of the fugue is its treatment of thematic material by means of imitation. This characteristic is typical also of the *fugato*, a passage employing fugal techniques within a composition, for instance, the sonata. The fugue, however, does not necessarily conform in every detail to a fixed form; see MUSIC: *Elements of Musical Organization: Form*. In the hands of its greatest masters, the fugue is a style of composition, depending on the rigorous contrapuntal exploitation of a single idea. Thus, a general discussion of the fugue is in reality a discussion of the most common techniques used by various composers of fugues. Any given fugue will adhere essentially to the abstract formula but will deviate from it in certain details.

Fugues may be written for a single instrument, such as the organ or piano, groups of instruments, or groups of voices either accompanied or unaccompanied by instruments. The number of parts or voices, at least two but most commonly four, remains constant throughout the piece. The parts are referred to generally by the designations of vocal music, that is, soprano, alto, tenor, and bass, even in an exclusively instrumental composition.

The principal structural components of the fugue are the exposition and the episode. The exposition comprises a succession of entrances of the different voices, each appearing once to state either the subject, or main theme, or the answer, or imitation of the subject. The episode consists of passages in free counterpoint intervening between two expositions. Thus, the entire fugue comprises several expositions and episodes.

The fugue opens with an exposition in which the subject is first stated by one voice. At the conclusion of this statement appears the answer, in which a second voice restates, or imitates, the subject, most frequently at a distance of five scale degrees above, or four scale degrees below, the initial statement. The answer may be a literal repetition of the subject or it may involve minor alterations for reasons of tonality. During the presentation of the answer the first voice continues with free counterpoint melodically unrelated to the subject; melodic figures derived from this portion, however, may enter the composition later. If the free counterpoint comprises a significant melody which makes subsequent appearances, the melody is called a countersubject. At the conclusion of the answer there may be a brief period of free counterpoint in both voices, but in a relatively short time a third voice enters with a statement of the subject. These alternate statements of

FUGUE



Manuscript of a fugue
for organ by Johann
Sebastian Bach.

Bettmann Archive

subject and answer continue until all the parts have entered. The voices already active continue in free counterpoint but sometimes remain silent for brief periods.

The first complete exposition is followed by an episode consisting of freely contrapuntal passages constructed of melodic figures derived from the subject, countersubject, or free counterpoint of the exposition. Subsequent expositions do not begin with solo statements of the subject as in the first exposition. Rather, each sustains the free contrapuntal texture of the preceding episode, thus maintaining a thematic continuity from one section to the next. In the first exposition the voices enter in fairly close

succession. In the later expositions they may be separated by greater time intervals, sometimes to such an extent that secondary episodes may be distinguished between their entrances. The middle expositions involve also modulation from the main key to closely related keys.

The fugue may employ additional contrapuntal devices, such as augmentation, the statement of the subject with the time values lengthened; diminution, the statement of the subject with the time values decreased; inversion, the repetition of the subject with a reversal of its intervals; stretto, a series of compressed imitative entrances, each voice beginning the subject before the preceding voice has finished stating

it; or pedalpoint, a tone in the bass sustained while the other voices continue in polyphony.

The polythematic fugue is either a double or triple fugue, which includes expositions on second and third subjects, respectively. Another type of double fugue is one in which the second subject appears as a countersubject in the first exposition and then is used throughout the piece. An example of this type of double fugue is found in the Kyrie in the *Requiem* of the Austrian composer Wolfgang Amadeus Mozart. Accompanied fugues are vocal fugues with an instrumental accompaniment melodically independent of the fugue proper.

History. The fundamental stylistic feature of the fugue, that is, imitation of a subject by successively entering voices, crystallized in the Renaissance motet (q.v.) and chanson around 1500. These forms developed into the immediate antecedents of the fugue, namely, the *ricercare* and the *canzona*, instrumental forms prominent in the 16th and the early 17th century; see CANZONE. Neither of these later forms, however, properly may be termed fugue, for they lacked the characteristics of cohesive thematic unity and strong key structure. Although the term "fuga" was in use in the 15th and 16th centuries, it actually denoted a canon (q.v.).

The Italian composer Girolamo Frescobaldi (1583–1643) wrote polythematic *ricercare*, in which the initial subject was eventually restated in augmentation or diminution, and monothematic *ricercare*, consisting of only one subject presented in successive sections which introduced countersubjects. These monothematic *ricercare* differ from the fugue chiefly in the harmonic relationship between subject and answer. Frescobaldi's technique was employed also in the *Fantasias* for organ by the Dutch organist and composer Jan Pieterzoon Sweelinck (1562–1621) and in the fugues of his pupil, the German organist and composer Samuel Scheidt (1587–1654). Both musicians used the techniques of augmentation, diminution, and stretto. Unlike Frescobaldi, in their works they achieved also a climax of rhythmic intensity commonly found in the later fugue. A further development is marked by the monothematic *ricercare* written for the harpsichord by the Italian composer Bernardo Pasquini (1637–1710), and by the fugues of Gioseffo Bencini (fl. first half of the 18th century), which distinguished clearly between expositions and episodes.

During the late baroque period (first half of the 18th century) the fugue was brought to a high point of development by a group of north German organists, many of whom were influ-

enced by Sweelinck. One of the most important composers of this group is Dietrich Buxtehude (1637–1707), whose fugues, based on bold subjects, show skillful use of contrapuntal technique and share also the sweeping, rhapsodic qualities of the toccatas (see TOCCATA) which precede them.

The two most important figures of the baroque era were the German composers Johann Sebastian Bach and George Frederick Handel, both of whom brought the fugue to the zenith of its development. Handel's accompanied choral fugues were the vehicle for the vivid drama of his oratorios. Bach thoroughly demonstrated all the nuances and artifices of the fugue in two collections of fugues, *Well-Tempered Clavier* and the unfinished *Art of the Fugue*. The former, forty-eight preludes and fugues, is a compendium of all types of fugue. It emphasizes the monothematic type, but also contains masterful illustrations of the polythematic types. In the *Art of the Fugue*, which employs only one subject throughout, Bach presents step by step all the resources of fugue writing from the simple to the most complex. These fugues, as well as many others by Bach, are distinguished by their striking subjects and by the concentration with which these subjects are elaborated into a unified whole.

During the entire baroque period fugues appeared often in sonatas, concerti, chorale preludes, oratorios, and cantatas, and in overtures to operas and suites. Independent fugues were written primarily for keyboard instruments, usually with introductory sections, in the form of preludes or toccatas. Classical composers such as Franz Joseph Haydn, Ludwig van Beethoven, and Mozart absorbed the fugal technique in their sonatas, symphonies, choral works, and string quartets; see MUSIC: *Preclassic and Classic Periods*. The fugal technique also became a part of the instrumental and vocal works of the Italian composer Maria Luigi Cherubini. In the late 19th century the technique was mastered by the German composer Johannes Brahms, the Austrian composer and organist Anton Bruckner, and the Belgian-French composer and organist César Auguste Franck. The fugal technique was also applied to operas by the German composer Richard Wagner in *The Mastersingers of Nuremberg* and the Italian composer Giuseppe Verdi in *Falstaff*. During the 20th century fugal techniques have been used by various composers, particularly by the German composer Max Reger. The composition for piano, *Ludus Tonalis*, by the German composer Paul Hindemith is a notable example of counterpoint that makes

FUJI

special use of the fugue in a contemporary idiom.

See separate articles for those individuals whose birth and death dates are not given.

F.M.S.

FUJI or **FUJIYAMA**, more correctly **FUJI-NO-YAMA** or **FUJISAN**, celebrated sacred volcano of Japan, about 70 miles s.w. of Tokyo, in the south central part of Honshu Island. Fuji, the highest mountain in Japan, rises as a cone to a height of 12,389 ft. above sea level, with the apex broken by a cone-shaped crater 2000 ft. in diameter. The southern slopes extend to the shore of Suruga Bay, and the isolated peak can be seen from many of the outlying prefectures. According to Japanese tradition, Fuji arose from the plain during a single night in 285 B.C. The latest recorded eruption of Fuji lasted from Nov. 24, 1707, until Jan. 22, 1708; since that time the volcano has been quiescent. As the sacred mountain of Japan, it is visited annually by thousands of pilgrims from all parts of the country, and numerous shrines and temples are situated on its slopes. The mountain figures frequently in Japanese literature and art.

FUKUOKA, city in Japan, and capital of Fukuoka Prefecture, on N.W. Kyushu Island, about 60 miles N.E. of Nagasaki. The city, divided by the

Naka R., includes Fukuoka, on the w bank, an old castle town of a family of feudal barons, and Hakata, on the e. bank, the main commercial section. It is the closest large Japanese port to the Asian mainland and is an important manufacturing center, producing silk products, dolls, porcelain, machinery, paper, and metal goods. Kyushu University, the chief state university of w. Japan, is in Fukuoka. Pop. (1970) 853,270.

FULA or **FULANI**, cattle-herding people of Africa, numbering about 7,000,000, and dispersed in varying, often sizable, concentrations throughout the grassland areas of west Africa from Senegal and Guinea to Nigeria, Cameroon, and Chad (qq.v.).

The Fula, although dark-skinned, show Caucasoid racial features; see **RACES OF MANKIND: Racial Classification**. Their language, however, is closely related to the languages of Senegal, suggesting the possibility that their ancestors migrated from the Middle East through north Africa to Senegal; see **AFRICAN LANGUAGES**. By the 10th century, they had adopted a new language in Senegal and begun to spread eastward, reaching present-day Nigeria by about the 14th century.

Although most Fula remained cattle-herders through the centuries, many settled down and

Snow-capped Mt. Fuji.
Japan National Tourist
Organization



turned to politics, successfully establishing a series of kingdoms between Senegal and Cameroon by the 19th century, and conquering the Hausa (q.v.) by about 1810. The Fula held much of northern Nigeria in subjection until defeated (1900–1906) by the British. In religion a large percentage of the cattle-herding Fula are animistic, although many of the politically oriented Fula are Muslim and have often justified their conquests on religious grounds; see ANIMISM; MUSLIM SECTS.

FULBRIGHT, J(ames) William (1905–), American educator and politician, born in Sumner, Mo., and educated at the University of Arkansas, the University of Oxford, and George Washington University Law School. He was admitted to the Washington (D.C.) bar in 1934 and served for a year as a special attorney in the United States Department of Justice. He taught at George Washington University (1935–36) and at the University of Arkansas (1936–39). He served as president of the last-named institution from 1939 until 1941. A member of the Democratic Party, Fulbright was elected to the United States House of Representatives in 1942 and to the United States Senate in 1944. In the Senate he sponsored the Fulbright Act of 1946, amended in 1961 by the Fulbright-Hays Act, providing for fellowships for Americans to study and teach abroad and for foreigners to study in the U.S.; see EXCHANGE PROGRAMS; FELLOWSHIP. Fulbright gained much influence as chairman from 1954 to 1974 of the Senate Committee on Foreign Relations. Running for his sixth Senate term in 1974, however, he was defeated in the Arkansas Democratic primary. In 1975 Fulbright retired to the private practice of law.

His support of American economic aid abroad and his opposition to U.S. military intervention abroad are set forth in his books, *Prospects for the West* (1963), *Old Myths and New Realities* (1964), *The Arrogance of Power* (1967), and *The Crippled Giant* (1972).

FULLER, Alfred Carl (1885–1973), American manufacturer, born in Kings County, Nova Scotia, Canada. At the age of eighteen he emigrated to Boston, Mass. Three years later, in 1906, he founded the Fuller Brush Company, in Somerville, Mass. The company, specializing in door-to-door sales of brushes and other Fuller products, had achieved annual sales of about \$50,000,000 by midcentury. Fuller, who became an American citizen in 1918, is the author of an autobiography, *A Foot in the Door* (1960).

FULLER, R(ichard) Buckminster (1895–), United States inventor, mathematician, architectural engineer, author, and educator, noted

for his holistic, global approach to long-range human problem solving and for his pioneering use of modern metals in designing new and unconventional structures.

Fuller was born in Milton, Mass., July 12, 1895. He attended Harvard University from 1913 to 1915, and by the 1920's his creativity was apparent in his design of the geodesic dome (a lattice of interlocking tetrahedrons and octahedrons), which could be quickly assembled from lightweight materials and was unlimited in potential dimensions (see below).

In 1932 Fuller founded the Dymaxion Corporation to produce a variety of his innovative designs. His inexpensive, factory-assembled, and highly portable Dymaxion house, which he regarded as a "dwelling machine", was a doughnut-shaped structure hung from a central mast; his Dymaxion map, still in use, reveals the surface of the earth without the usual visible distortions of world maps. His Dymaxion car, which was never mass-produced, was a three-wheeled, 90-h.p. automobile capable of traveling at 120 m.p.h., with low gas consumption and turning in its own length. The Dymaxion projects were suspended during World War II, and after the war Fuller focused his attention on the geodesic dome.

Because of his lack of formal education, Fuller's work was ignored by professionals for many years. Only after the geodesic dome (patented in 1947) first achieved recognition in the early 1950's did the critical significance of his designs and design method begin to be acknowledged. Possessed of remarkable foresight in analyzing the most efficient development of human resources, Fuller evolved a philosophy of anticipatory design: "My ideas have undergone a process of emergence by emergency. When they are needed badly enough, they're accepted. So I just invent. Then I wait until man comes around to needing what I've invented".

The domes, it developed, were needed, and in time they brought him worldwide renown. Some 2000 of his geodesic structures have been erected in more than thirty countries, the most famous being the U.S. pavilion at Expo '67 in Montréal, Canada, and the Union Tank Car dome in Baton Rouge, La. In 1959 he became a research professor at the University of Southern Illinois, Carbondale, where he established his World Game research team for the application of design theory to the security of mankind and preservation of the earth. Among his many books are *Nine Chains to the Moon* (1938, reprinted 1963), the basic statement of his

position, and *Operating Manual for Spaceship Earth* (1969).

FULLER, (Sarah) Margaret, Marchioness Ossoli (1810–50), American feminist, social reformer, and author, born in Cambridge, Mass., and educated chiefly by her father, the American lawyer and legislator Timothy Fuller (1778–1835). At an early age she displayed remarkable intellectual powers, becoming, while a young woman, a member of the group of distinguished writers and philosophers who met frequently in the Boston area and who espoused the doctrines of transcendentalism (q.v.). From 1835 to 1837 she taught languages in Boston, and in the latter year became principal teacher at the Green Street School, Providence, R.I., where she served for two years. In 1839 her translation of *Conversations with Goethe* by the German writer Johann Peter Eckermann (q.v.) was published. In the following year she founded, with the aid of the American poet and essayist Ralph Waldo Emerson (q.v.) and the critic and reformer George Ripley (1802–80), the *Dial*, a periodical embodying in verse and philosophical writings the beliefs of the transcendentalists. For about five years beginning in 1839, she organized gatherings of women in Boston for the intellectual and social development of the participants. These meetings provided her with much of the material used in *Women in the Nineteenth Century* (1845), in which she expounded the doctrine of equal rights for women. From 1844 to 1846 she was literary critic for the New York *Tribune*, gaining recognition as one of the foremost critics in the United States. In 1846 she journeyed to Europe, from where she dispatched letters to the *Tribune* describing her experiences. While visiting Rome, Italy, in 1847 she met and married Marquis Giovanni Angelo Ossoli (1820?–50), a follower of the nationalist revolutionary Giuseppe Mazzini (q.v.). She remained in Rome after the outbreak of the revolution of 1848, and when the city was besieged by French forces in 1849, she assumed the direction of one of its hospitals while her husband took part in the fighting. They escaped on the fall of the city, and in 1850, with their infant son, embarked for the United States, but the ship was wrecked off Fire Island, N.Y., and all three were drowned.

FULLER, Melville Weston (1833–1910), American politician and jurist, born in Augusta, Maine, and educated at Bowdoin College and Harvard Law School. He was admitted to the bar in Augusta in 1855 and in the following year he moved to Chicago, Ill., where he established a successful law practice. Beginning in 1862,

when he was a member of the Illinois State Constitutional Convention, and for the next eighteen years, Fuller was active in the Democratic Party (q.v.). He was a delegate from Illinois to the national conventions of the party from 1864 to 1880. Fuller became the eighth chief justice of the Supreme Court of the United States (q.v.) in 1888. During his tenure of twenty-two years he helped to broaden the powers of the Federal courts. In 1899 he served on the commission to arbitrate the Venezuela boundary dispute (see *VENEZUELA: History*). From 1900 until his death Fuller also served as a member of the Permanent Court of Arbitration (q.v.). **FULLER, Thomas** (1608–61), English writer and clergyman, born in Aldwinckle Saint Peter, Northamptonshire, and educated at Queen's College, University of Cambridge. In 1630 his uncle, John Davenant (1576–1641), the bishop of Salisbury, appointed him a prebendary at Salisbury Cathedral. In 1634 Fuller became rector of Broadwindsor, Dorsetshire, where he wrote an account of the Crusades, *The Historie of the Holy Warre* (1639), and a book of precepts for leading a good life, *The Holy State and the Prophane State* (1642). His first book of sermons, *Joseph's Party-Coloured Coat* (1640), is distinguished by the conceits and wit characteristic of the sermons of his period. In 1642 Fuller settled in London, where he preached in favor of the signing of articles of peace by both royalists and parliamentarians in the Great Rebellion (q.v.). In 1643 he joined the forces of Charles I (q.v.), King of England, at Oxford, as chaplain to one of his regiments. During this period he collected the materials for *The Church History of Britain, from the Birth of Christ until the Year 1648* (1655) and *The Worthies of England*, printed in the year following his death; and he compiled two small books of meditations and prayers, *Good Thoughts in Bad Times* (1645) and *Better Thoughts in Worse Times* (1647). After the cessation of hostilities he wrote *A Pisgah-Sight of Palestine* (1650), and a decade later, after the restoration of Charles II (q.v.) to the English throne, *A Panegyrick to His Majesty on his Happy Return*. He was then appointed chaplain in ordinary to the king.

FULLERTON, city of California, in Orange Co., on Fullerton and Brea creeks, adjoining Anaheim on the N., and 22 miles S.E. of Los Angeles. The Coyote Hills occupy the unpopulated northwestern part of the city. Citrus fruit, avocados, and walnuts are grown in the surrounding area, which also produces oil. Important industries are fruit packing and the manufacture of asbestos, steel, aluminum, electrical equip-

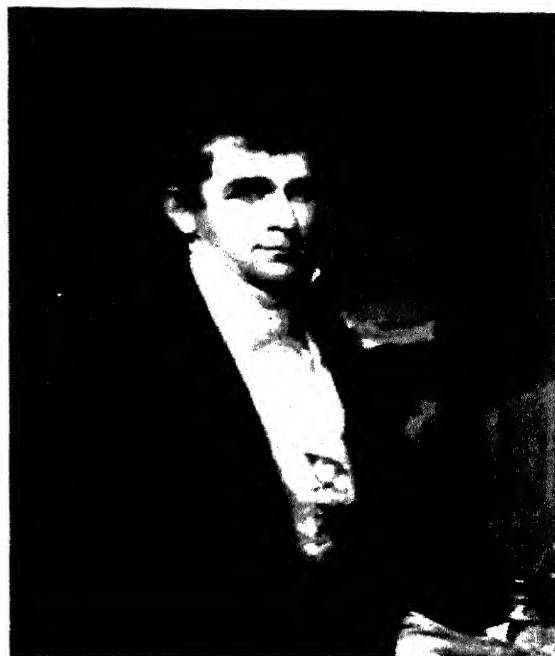
ment, glass and paper products, and precision instruments. Fullerton was founded in 1887 and incorporated as a city in 1904. Pop. (1960) 56,180; (1970) 85,826.

FULMAR, large sea bird of the family Procelariidae, celebrated as a scavenger. The fulmars feed on discarded organic matter, and are especially fond of whale blubber. They breed on cliffs, laying a single white egg in a rock crevice. *Fulmarus glacialis* is found in the North Atlantic from north of Greenland to Massachusetts, occasionally flying as far south as New Jersey, and is especially abundant off the Hebrides Islands of Saint Kilda and Skye, in Scotland. The size and color of this bird are similar to that of the herring gull.

FULMINATES, salts of fulminic acid, a volatile, poisonous, explosive liquid with the formula HONC, which is isomeric with cyanic acid. Fulminic acid has not been isolated in a pure state because of its instability. The fulminates, although more stable than the acid, are all readily explosive when heated or struck. Fulminates were prepared as early as 1798, and their explosive properties were recognized and utilized. See EXPLOSIVES: *Detonators*.

FULTON, city in Missouri, and county seat of Callaway Co., about 23 miles N.E. of Jefferson City. The city has light manufacturing. It is the site of Westminster College, founded in 1851, and William Woods College, founded in 1870. Pop. (1960) 11,131; (1970) 12,148.

FULTON, Robert (1765–1815), American inventor and engineer, born in Lancaster County, Pa. As a young man he painted portraits and landscapes as a profession, and in 1786 went to England, where he studied with the American painter Benjamin West (q.v.) until about 1793. Thereafter Fulton abandoned painting and turned to the study of mechanics and engineering. He became actively interested in the improvement of canal navigation, and in 1794 obtained a British patent for an inclined plane designed to replace canal locks. Soon after he patented machines for sawing marble, for spinning flax, and for twisting hemp into rope; he also patented several types of boats. At the invitation of the United States minister to France, Fulton went to Paris, where he invented a submarine and conducted his first successful experiments with a boat propelled by steam. In 1806 Fulton returned to New York, where he pursued his experiments with steam-driven boats with the financial backing of the American diplomat Robert R. Livingston (see under LIVINGSTON). In 1807, Fulton launched a steamboat, the *Clermont* (q.v.), on the Hudson River,



Robert Fulton (self-portrait, about 1807)
William Rockhill Nelson Gallery of Art and Atkins Museum of Fine Arts,
Kansas City, Mo.

and received an American patent for the construction of the steamboat.

Although Fulton was not the first to apply steam to navigation, he was the first to achieve any practical success. He was employed by the U.S. government to work on various navigation projects. In 1814–15 he constructed *Fulton the First*, a 38-ton vessel which was the first steam-propelled warship. He wrote *A Treatise on the Improvement of Canal Navigation* (1796) and *Torpedo War and Submarine Explosions* (1810). **FUNABASHI**, city of Japan, in Chiba Prefecture, on Honshu Island, at the N.E. end of Tokyo Bay, 14 miles E. of Tokyo. The city, a road hub and a rail junction on the Sobu line, manufactures wood products, flour, and pens. Funabashi has fish hatcheries and one of the largest fish markets in the Tokyo area. The Hokekyoji Temple, built in 1260 and sacred to the Nichiren Buddhist sect, is 2 miles W. at Shimosanakayama. Pop. (1970) 325,426.

FUNCHAL, city in Portugal, and capital of Funchal Province, on Funchal Bay, on the S. shore of the island of Madeira, 660 miles S.W. of Lisbon. Industries in the city include sugar and flour milling, wine production, fruit canning, and the manufacture of tobacco products and soap. Fish, fruit, and the famous Madeira wines, embroideries, and laces are exported. The city, sometimes called the "Pearl of the Ocean", is a noted winter resort because of its beaches and

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mild climate. Funchal is the site of the remains of 16th- and 17th-century forts and of the 15th-century Cathedral of Santa Clara, which contains the tomb of João Gonçalves Zarco, discoverer of Madeira and founder of Funchal. Founded in 1421 and chartered in 1508, the city was under Spanish rule from 1580 to 1640 and was occupied by the British in 1801 and 1807. Pop. (1970) 33,750.

FUNCTION, in mathematics, term used to indicate the relationship or correspondence between two or more quantities. The term "function" was first used in 1637 by the French mathematician René Descartes (q.v.) to designate a power x^n of a variable x . In 1694 the German mathematician Baron Gottfried Wilhelm von Leibniz (q.v.) applied the term to various aspects of a curve, such as its slope. The meaning used most widely until quite recently was defined in 1829 by the German mathematician Peter Gustav Lejeune Dirichlet (1805–59). Dirichlet conceived of a function essentially as a variable y , called the dependent variable, having its values fixed or determined in some definite manner by the values assigned to the independent variable x , or to several independent variables x_1, x_2, \dots, x_k .

The values of both the dependent and independent variables were real or complex numbers. The statement $y = f(x)$, read "y is a function of x", indicated the interdependence between the variables x and y ; $f(x)$ was usually given as an explicit formula, such as $f(x) = x^2 - 3x + 5$, or by a rule stated in words, such as $f(x)$ (for real x 's) is the first integer larger than x . If a is a number, $f(a)$ is the value of the function for the value $x = a$. Thus, in the first example, $f(3) = 3^2 - 3 \cdot 3 + 5 = 5$, $f(-4) = (-4)^2 - 3(-4) + 5 = 33$; in the second example, $f(3) = f(3.1) = f(\pi) = 4$.

The emergence of set theory first extended and then altered substantially the concept of a function. The function concept in present-day mathematics may be illustrated as follows. Let $X = [x]$ and $Y = [y]$ be two sets with quite arbitrary elements; in particular, the elements may or may not be numbers, and the elements of X are not necessarily of the same type as those of Y . For example, X might be the set of the fifty States of the United States and Y the set of positive integers. Let P be the set of all possible ordered pairs (x, y) and F a subset of P with the property that if (x_1, y_1) and (x_2, y_2) are two elements of F , $y_1 \neq y_2$ implies that $x_1 \neq x_2$; that is, F contains no more than one ordered pair with a given x as its first member. (If $x_1 \neq x_2$, it may happen that $y_1 = y_2$.) A function is now re-

garded as the set F of ordered pairs with the stated condition and is written $F: X \rightarrow Y$. The set X_1 of x 's that actually occur as first elements in the ordered pairs of F is called the domain of the function F ; the set Y_1 of y 's that occur as second elements in the ordered pairs is called the range of the function F . Thus, $\{(\text{New York}, 7), (\text{Ohio}, 4), (\text{Utah}, 4)\}$ is one function defined by the above example; the domain is the three states named, and the range is 4, 7.

The modern concept of a function is related to the Dirichlet concept. Dirichlet regarded $y = x^2 - 3x + 5$ as a function; today, $y = x^2 - 3x + 5$ is thought of as the rule that determines the correspondent y for a given x of an ordered pair of the function; thus, the preceding rule determines $(3, 5)$, $(-4, 33)$ as two of the infinitely many elements of the function. Although $y = f(x)$ is still used today, it is better to read it as "y is functionally related to x".

A function is also called a transformation or mapping in many branches of mathematics. If the range Y_1 is a proper subset of Y (that is, at least one y is in Y but not in Y_1), F is a function or transformation or mapping of the domain X_1 into Y ; if $Y_1 = Y$, F is a function or transformation or mapping of X_1 onto Y . J.Si.

FUNCTIONALISM, or FUNCTIONAL PSYCHOLOGY, school of psychological thinking that stressed the study of the mind as a functioning and useful part of the organism. The functionalist attitude was a natural outcome of the widespread interest in Darwinism and the doctrine of "the survival of the fittest"; see EVOLUTION. Functionalism emphasized such techniques as human-intelligence tests and controlled experiments designed to test the ability of animals to learn and to solve problems. This type of investigation represented a clear break with the introspective methods favored by other 19th-century psychologists. William James (q.v.) was one of the earliest proponents of the functionalist approach, and John Dewey (q.v.) was the first to teach the doctrine formally. From about 1890 to 1910 functionalism was the most important movement in psychology. In many respects it was the precursor of behaviorism (q.v.). Functionalism is no longer regarded as a separate psychological doctrine, but its viewpoint has had a lasting influence on such fields of modern applied psychology as intelligence and aptitude testing; see PSYCHOLOGICAL TESTING; PSYCHOLOGY. L.C.

FUNDAMENTALISM, conservative movement among Protestants in the United States, which began in the late 19th century. It emphasized as absolutely basic to Christianity the following

beliefs: the infallibility of the Bible, the Virgin Birth and the deity of Jesus Christ, the sacrifice of Christ on the Cross as atonement for the sins of all men, the physical resurrection and Second Coming of Christ, and the bodily resurrection of believers.

Origins. Fundamentalism is rooted in 18th- and 19th-century American revivalism; see REVIVALS, RELIGIOUS. Until the middle of the 19th century, its principal beliefs were held by almost all orthodox Protestant denominations, particularly by evangelical denominations; see EVANGELICAL; EVANGELIST. Fundamentalism as an organized, conservative movement dates from the early part of the 20th century. It developed out of a series of Bible conferences, the first ones held in 1876. These were called by members of various denominations who strongly objected to the historical-literary study of the Bible, known as the higher criticism (see BIBLE SCHOLARSHIP); the attempts (still continuing) to reconcile traditional Christian beliefs and doctrines with contemporary human experience and knowledge; and the acceptance of a scientific view of the world, particularly the popularization of the theory of evolution (q.v.). Such trends and beliefs were opposed by many conservative members of Protestant denominations. See also MODERNISM.

The more conservative members of each denomination at first attempted to exclude from their own institutions persons they considered to be outspoken or unyielding liberals. As a result a number of clergymen and theologians were dismissed for espousing higher criticism. The exceptionally conservative, however, set up various rival bodies and educational institutions to spread their creed.

Fundamentalism began to flourish in 1909 with the publication and distribution of twelve books called *The Fundamentals*. By the time the twelfth of the series had been published, about 3,000,000 copies of *The Fundamentals* had been distributed throughout the U.S. and abroad. About this time too, a number of Bible institutes, such as the Los Angeles Bible Institute, and the Moody Bible Institute in Chicago, Ill., were established or began to teach Fundamentalist beliefs and doctrines; see also MOODY, DWIGHT LYMAN.

Current Status. Fundamentalism spread in the 1920's. It was strongest in rural areas, particularly in California, in the border States, and in the South. In these areas, Fundamentalists sharply delineated the issue of Biblical infallibility in historical and scientific matters. The controversy over this issue grew most intense in the secular

sphere when Fundamentalists urged many States to pass legislation forbidding the teaching of evolution in public schools. Several Southern and border States, among them Tennessee, passed such laws. The Tennessee statute led, in 1925, to the world-famous trial of John Thomas Scopes (1901-70), a high-school instructor, who was convicted for teaching evolution in defiance of law. The orator and politician William Jennings Bryan was an associate prosecutor at the trial; the lawyer Clarence Seward Darrow (qq.v.) defended Scopes. In 1968 the U.S. Supreme Court ruled that the Tennessee law was unconstitutional.

Fundamentalism lost momentum in the early 1930's. The main reasons were the acceptance by most Americans of modern scientific theories and methods and more liberal religious doctrines, as well as the lack of an effective national organization to lead the Fundamentalist associations. Fundamentalism has since revived, however, primarily as reaction to two currently dominant theological movements, ecumenicity (see ECUMENICAL MOVEMENT), and neoorthodoxy (see THEOLOGY). Since the 1940's Fundamentalists have spent large sums annually to broadcast radio programs about their views on the Bible. They have set up national associations to provide resource materials and high standards for primary, secondary, and higher educational institutions. In this, two organizations have been exceptionally active: the American Council of Christian Churches, and the National Association of Evangelicals. In 1948 an international Fundamentalist group was formed; centered in Amsterdam, the Netherlands, the International Council of Christian Churches claims support from forty-five rather small denominations in eighteen countries. At the founding convention, some members of this group opposed the stated purposes of the World Council of Churches (q.v.) and offered their group as an alternate to the council.

E.C.B.

FUNDAMENTAL ORDERS OF CONNECTICUT. See CONNECTICUT: *History*; HAYNES, JOHN; HOOKER, THOMAS.

FUNDY, BAY OF, large tidal inlet of the North Atlantic Ocean, separating the provinces of New Brunswick and Nova Scotia, s.e. Canada, and bordering on s.e. Maine. It is about 275 km (171 mi.) long and up to 80 km (50 mi.) wide. In the e., Fundy divides into two arms, Chignecto Bay on the n. and Minas Channel (which leads into Minas Basin) on the s. The funnel effect of these narrowing arms increases the tidal range of the bay, and at times the water in the arms rises by as much as 18 m (about 60 ft.), creating one of

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the world's highest tides. The tidal surge in Chignecto Bay produces a large crested wave, or bore (q.v.), ranging to 1.8 m (6 ft.) in height, in the lower Petitcodiac R. The rising tide in Fundy proper creates a "reversing falls" on the lower Saint John R., at Saint John, New Brunswick. Passamaquoddy Bay (q.v.), a w. arm of Fundy, forms part of the boundary between New Brunswick and Maine. Although Fundy is very deep, navigation is difficult because of the rapid rise and fall of the tide. Major deepwater harbors are at Saint John and at Digby and Hantsport, Nova Scotia. Fundy National Park borders the bay in New Brunswick. The bay was discovered by the French explorer Pierre du Guast, Sieur de Monts, in 1604.

FUNERAL RITES. See MORTUARY CUSTOMS.

FUNGI, diverse group of either single-celled or multicellular organisms that obtain food by direct absorption of nutrients. The food is dissolved by enzymes which the fungi excrete, is then absorbed through thin cell walls, and is distributed by simple circulation, or streaming, of the protoplasm (q.v.). Together with bacteria (q.v.), fungi are responsible for the decay and decomposition of all organic matter and are found wherever other forms of life exist. Some are parasitic on living matter and cause serious plant and animal diseases; see PARASITE. The study of fungi is called mycology.

Fungi were traditionally classified as a division in the kingdom Plantae. They were thought of as plants that have no stems or leaves and that in the course of becoming food absorbers lost the pigment chlorophyll, which is needed for conducting photosynthesis (q.v.). Most scientists today, however, view them as an entirely separate group that evolved from unpigmented flagellates (q.v.) and place them either in the kingdom Protista (q.v.) or the kingdom Fungi, according to their complexity of organization; see CLASSIFICATION. Approximately 100,000 species of fungi are known. The more complex groups are believed to have derived from the primitive types, which have flagellated cells at some stage in their life cycle.

Structure. Most fungi are composed of delicate protoplasm-containing tubes known as hyphae, which frequently are partitioned by dividing walls called septa. One or two nuclei are found in each hyphal cell, and protoplasm moves through a tiny pore in the center of each septum. In the algaelike fungi of the phylum Zygomycota, however, the hyphae ordinarily do not have septa, and numerous nuclei are scattered throughout the protoplasm. Hyphae grow by elongation at the tips and also by branching.

The resulting profusion of hyphae is called the mycelium. Abundant development of mycelium may result in the formation of large fruiting structures such as mushrooms and puffballs. Other types of massive hyphal structures enable some fungi to exist under difficult conditions or to spread to suitable nutritional sources. The cordlike strands of mycelium of the honey mushroom, *Armillaria mellea*, enable it to spread from the roots of one tree to another. Some fungi form very resistant, more or less spherical masses of mycelium called sclerotia, which may be smaller than grains of sand or as large as cantaloupes. Among the fungi with large sclerotia are various bracket fungi; an outstanding example is the large edible sclerotium (or tuckahoe) of *Poria cocos*.

Reproduction. Most fungi reproduce by spores, which are tiny particles of protoplasm enclosed in walls; see SPORE. The common mushroom *Agaricus campestris* may form two billion or more spores on its fruiting body; the giant puffball *Calvatia gigantea* may produce several trillion. See MUSHROOMS.

Spores are usually formed in one of two ways. In one process the spores form after the union of two or more nuclei within a specialized cell or series of cells. These spores typically germinate into hyphae that have different combinations of the hereditary characteristics of the parent nuclei. The four types of spores that are produced in this way—oospores, zygosporos, ascospores, and basidiospores—are representative of the four principal groups of fungi. Oospores are formed by sexual union of a male and a female cell, zygosporos by conjugation of two similar sex cells. Ascospores are spores (usually eight) that are contained in sacs (asci), and basidiospores (usually four) are contained in clublike structures (basidia).

The other usual method of spore production involves the transformation of hyphae into numerous short segments or into various kinds of more complicated structures. Here, the fusion of two nuclei is not a requirement. The principal reproductive spores formed in this asexual manner include oidia, conidia, and sporangiospores. Sporangiospores are formed inside bladderlike containers called sporangia. Most fungi produce spores both sexually and asexually.

Classification. Although relatively complicated systems of fungus classification are used in various textbooks, mycologists commonly employ a simple system that has the merit of convenience. In this system the four main phyla are the Oomycota, Zygomycota, Ascomycota, and Basidiomycota, which respectively produce



oospores, zygospores, ascospores, and basidiospores. A large variety of species are loosely placed in a fifth major phylum, Deuteromycota (also called Fungi Imperfecta), because they are not known to produce spores by fusion of nuclei and are therefore difficult to classify. Most, however, seem to be related to Ascomycota.

Several other phyla are considered to be fungi or closely related to fungi: Actinomycota, Myxomycota, Plasmodiophoromycota, Labyrinthulomycota, and Acrasiomycota. The Actinomycota, with very delicate hyphae and reproduction usually by oidia or conidia, are grouped as intermediate between bacteria and fungi. The Myxo-

Four types of fungi. Top, left: Claviceps purpurea, an ascomycete, growing on grain heads of rye. Top, right: Honey mushroom (Armillaria mellea), a basidiomycete, with masses of hyphae growing in strands. Above, left: Species of black bread mold (Rhizopus stolonifer), a zygomycete of the order Mucorales. Above, right: Stinkhorn (Dictyophora duplicata), a basidiomycete of the gasteromycete group, order Phallales.

mycota (q.v.), or true slime molds, are included among the fungi by some mycologists and placed with the animal-like protists by others. In this group the nutritional phase is an unwallled mass of amoebalike protoplasm, called a plasmodium. The reproductive phase includes swimming cells, called swarm cells, which are

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propelled by two flagella of unequal length. The Plasmodiophoromycota resemble Myxomycota in having swarm cells and a plasmodial stage. The Labyrinthulomycota and Acrasiomycota have some slime mold characteristics but their nutritional stage—called the pseudoplasmodium—is somewhat different.

OOMYCOTA. The phylum of oomycetes is composed of algaelike fungi, ranging from a single cell to a complex mass of hyphae that are not walled off by septa (nonseptate mycelium). Besides forming oospores, the oomycetes form zoospores that move about by two flagella. Included in the phylum are water molds, white rusts, and downy mildews. Most water molds live on dead matter, but *Saprolegnia parasitica* invades living fish. The white rusts and downy mildews, belonging to the order Peronosporales, are parasitic on plants; see *Plant-Disease Fungi*, below. In some downy mildews, including *Phytophthora* and *Peronospora*, the spore cases containing the zoospores may be modified to resemble and function as conidia.

CHYTRIDIOMYCOTA. Chytrids are regarded as closely related to the Oomycota. In some classification systems they are considered protists rather than true fungi. Chytrids have one-celled subspherical bodies, some with delicate, root-like outgrowths. In some species these outgrowths may elongate and develop new fungus bodies at their tips. Oospores are formed by some chytrids. In addition, zoospores with a single flagellum may be produced.

ZYGOMYCOTA. The zygomycetes are characterized by the formation of sexual, thick-walled zygospores and asexual, nonswimming sporangiospores. Black bread mold (*Rhizopus nigricans*), a well-known representative of this group in the order Mucorales, forms a mass of hyphae on stale bread, fruits, and other foodstuffs. Fungi in the order Entomophthorales are parasitic on flies and other insects; they have single sporangiospores in spore cases, and each spore case develops into a structure that becomes detached and functions as a conidium. The order Zoopagales includes fungi parasitic on amoebae, nematodes, and arthropods.

ASCOMYCOTA. Ascomycetes, also called sac fungi, bear a definite number of ascospores inside a bladderlike sac called an ascus. Except for some yeasts and a few other types, ascomycetes have well-developed hyphae, usually with a single nucleus in each hyphal cell. Certain cells become binucleate shortly before formation of the spore sacs. Nuclear union occurs in the young ascus; division usually produces eight daughter nuclei which become centers of ascospore for-

mation. Some ascomycetes have only one ascospore; others may have up to several hundred.

The three main classes of Ascomycota are the Hemiascomycetes, Euascomycetes, and Loculoascomycetes. The Hemiascomycetes include yeasts and similar fungi which do not have asci formed within or on a supporting hyphal mass. Brewer's yeast (*Saccharomyces cerevisiae*), in addition to forming ascospores, reproduces by forming protuberances, or buds, that eventually pinch off from the parent cell. The yeasts of the genus *Schizosaccharomyces* divide by fission. The Taphrinales, such as the parasite causing peach leaf curl, often are included as an order of Hemiascomycetes, but their true relationship is uncertain.

The simplest forms of Euascomycetes are those, as in the order Eurotiales, in which asci are scattered throughout the interior of a ball of hyphae called a cleistothecium. *Penicillium* and *Aspergillus* are conidial stages of the Eurotiales. The Erysiphales, a group of plant parasites called the powdery mildews, have cleistothecia of specialized form. Some ascomycetes, known usually as Pyrenomycetes, have asci formed inside flask-shaped structures called perithecia. Many perithecia may be borne on a supporting mass of hyphae called an ascocarp. The morels, truffles, and cup fungi are well-known ascocarps, with asci borne at the upper surface. Another Pyrenomycete, the genus *Neurospora*—familiar as a red bread mold—has been used extensively in the study of heredity (q.v.).

The Loculoascomycetes differ from the groups previously described by having double-walled asci formed within holes in the interior of hyphal masses. Representative orders are the Myriangiales, Dothideales, and Pleosporales.

BASIDIOMYCOTA. This phylum comprises numerous and varied types of fungi whose reproductive structures are the basidia, located at the tips of the hyphae and usually bearing four basidiospores on stalklike protrusions. The basidia may be club-shaped, cylindrical, or oval. The two principal classes of Basidiomycota are the Heterobasidiomycetes, which commonly have four-celled basidia, and the Homobasidiomycetes, typically with one-celled basidia.

The Heterobasidiomycetes include some important plant parasites, such as the rusts in the order Uredinales and the smuts in the order Ustilaginales. These groups have basidia which are either deeply cleft or divided into several cells, usually four, each of which produces a spore.

Many rusts, including *Puccinia graminis*, the black stem rust of wheat and other grains, have a very complicated life cycle, requiring growth

on two different hosts for production of the various spore forms. In the black stem rust, small, flask-shaped structures, known as the spermatogonia, bear numerous tiny, sporelike bodies, called spermatia, on the upper surfaces of barberry leaves. On the lower surfaces develop cup-shaped structures called aecia, from the bases of which arise rows of aeciospores. The aeciospores never reinfect barberry, but attack only grain plants, producing clusters of red, spore-containing pustules, called uredia, which give a rustlike appearance to the plant stems and leaves. Later in the season, another type of spore known as the teliospore, or winter spore, which is black and thick walled, is produced on the wheat stem. In the following spring the teliospores develop cylindrical projections, each of which divides into four cells bearing individual basidiospores.

Rusts which alternate between two hosts are termed heteroecious; those which have all stages of development confined to one host are monoecious.

In the smuts the teliospores are known as chlamydospores. These spores may soon reinfect the host plant, but usually germinate in the soil the next spring and produce a short filament of approximately four cells, which bear basidiospores called sporidia.

The remaining Heterobasidiomycetes include various jelly fungi in the orders Auriculariales, Dacrymycetales, and Tremellales. Certain species of the Auriculariales are parasitic on scale insects.

The Homobasidiomycetes are subdivided into two main groups: the Hymenomycetes, in which the fruiting surface, or hymenium, is external; and the Gasteromycetes, in which the basidia are formed inside the fruiting body. These groups may be regarded as subclasses of the Homobasidiomycetes. Most of these fungi are saprophytic, that is, they live on dead or decaying organic matter.

The Hymenomycetes include the families comprising the mushrooms, coral fungi, and the pore, or bracket, fungi, which differ in the type of fruiting body, or basidiocarp. In the mushrooms, which are known as gill fungi, Agaricaceae, the hymenium is formed along the sides of elongated blades, or gills. Coral fungi, Clavariaceae, have a multibranched basidiocarp, with the hymenium on its smooth surface. In the bracket fungi, Polyporaceae, common on rotting logs, the hymenium lines the inside of tubes. Tooth fungi, Hydnaceae, have the hymenium on spiny outgrowths.

The Gasteromycetes include such familiar

forms as the puffballs in the order Lycoperdales and stinkhorns in the order Phallales. The basidiocarps of the puffballs often are very large, globular structures, containing enormous numbers of spores. The fruiting body of the stinkhorns is a cylindrical structure, and the spore-bearing surface at the apex of the structure emanates a foul odor which attracts carrion-feeding insects and thus ensures dissemination of the spores.

DEUTEROMYCOTA. These fungi are conidial stages mostly of ascomycetes and less commonly of zygomycetes or basidiomycetes. Classification of deuteromycetes depends on the form of the fruiting structures, the method of conidium production, and the form and color of the conidia and the hyphae that bear them. Oidia or conidia are formed usually on a fluffy down of loosely interlaced hyphae in the order Moniliales, represented by such genera as *Aspergillus*, *Penicillium*, *Verticillium*, *Alternaria*, and *Fusarium*. The Melanconiales, with genera such as *Colletotrichum*, have minute, saucerlike fruiting structures (acervuli). The conidia of the Sphaeropsidales are formed inside of flask-shaped structures (pycnidia).

Fungus Physiology. Most fungi have hyphal walls consisting primarily of a white, horny substance known as chitin and also contain some hemicelluloses. Cellulose is found in only a few groups of fungi, but is characteristic of the Oomycota. The water content of jelly fungi in the Heterobasidiomycetes often is more than 90 percent. Spores may have less than 50 percent water content, and dormant structures such as sclerotia contain even less. Fungi require free oxygen and large amounts of water and of carbohydrates or other carbon sources for growth. Sugars such as glucose and levulose are utilizable by most fungi, but the use of other carbon sources depends on the ability of the fungus to produce suitable enzymes (q.v.). Some of the mycorrhizal fungi may utilize nitrogen from the atmosphere, but all of the others depend on nitrates, ammonium salts, or other inorganic or organic nitrogen compounds. Other elements necessary for fungus growth include potassium, phosphorus, magnesium, and sulfur. Traces of iron, manganese, copper, molybdenum, zinc, and gallium and small amounts of growth substances also are necessary; see TRACE ELEMENTS; VITAMIN. Some fungi are at least partially deficient in one or more growth substances such as thiamine, biotin, pyridoxine, pantothenic acid, *i*-inositol, nicotinic acid, and riboflavin. Because some fungi are deficient in certain vitamins they may be utilized for accurate vitamin assay.

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The enzymes of fungi enable them to act upon a variety of substances. A group of enzymes, called the zymase complex, permits yeasts to carry on alcoholic fermentation; see FERMENTATION; ALCOHOL: *Ethyl Alcohol*. Other enzymes, including protopectinase, pectase, and pectinase, which are elaborated by such fungi as *Botrytis cinerea* and *Aspergillus oryzae*, hydrolyze pectic substances contained in the middle layers of plant-cell walls. Amylase, cellobiase, cytase, dextrinase, invertase, lactase, maltase, protease, and tannase are among the other enzymes produced by fungi.

Glycogen, a substance related to starch and dextrin, is the most common reserve carbohydrate of fungi. In addition, various fungi form polysaccharides and polyhydroxy alcohol such as mannitol and glycerol (see GLYCERIN). Proteins and fats are produced in abundance by some fungi. Oxalic acid and other organic acids such as citric, formic, pyruvic, succinic, malic, and acetic acids are formed by many fungi, but lactic acid production is largely confined to the Mucoraceae. Other fungus products include complex sulfur compounds, chlorine-containing substances, and numerous pigments. A few fungi are able to form volatile arsenic compounds when growing on arsenic-containing substrates. **Fungus Ecology.** Spores and hyphal fragments of fungi are carried for long distances in the atmosphere. Spores of *Cladosporium* are especially abundant in the air. In the midwestern United States wheat rust is spread largely by infection from urediospores blown northward from Mexico in the early spring.

Water habitats often abound with chytrids and water molds. A number of ascomycetes and deuteromycetes also frequent either fresh or salt water. Many fungi have structural modifications that seem to be especially adapted to the aqueous habitat. In recent years many fungi have been discovered in polluted rivers and streams. These fungi participate in the natural decomposition of sewage. Of special interest, because they cause disease in man, are the species *Aspergillus fumigatus* and *Geotrichum candidum*, which have been isolated from polluted water.

Soil is a natural habitat for saprophytic fungi, which live on organic remains, as well as a reservoir for parasitic fungi, which infect living plants and animals. The water molds, downy mildews, and Mucorales are common soil inhabitants, as are various Eurotiales, other ascomycetes, and many deuteromycetes. Many soil-inhabiting fungi decompose cellulose and proteins and thus are active in the formation of humus (q.v.). The truffle fungi form subterranean

fruiting bodies which are dug up and eaten as delicacies.

Certain fungi live in a symbiotic association with algae, forming characteristic structures known as lichens (q.v.); see SYMBIOSIS. The algae, living within the fungus mass, are furnished with a moist, protected environment, while the fungus obtains carbohydrates elaborated by the algae. Most lichen fungi are ascomycetes, but the fungus components of *Cora pavonia* and a few other species are basidiomycetes. Fungi that are intimately associated with roots of higher plants form mycorrhiza, a specialized type of hyphal growth in which a portion of the mycelium either wraps itself around the tips of roots, forming a velvety white cover, or penetrates into the cortex of the root. A number of plants seem to be dependent on this relationship for satisfactory development. Certain species of mushrooms are prominent in forming mycorrhizae.

Plant-Disease Fungi. Some fungi, which ordinarily grow on dead organic matter, are capable of infecting live plants when given the opportunity. Others cannot exist except as parasites of living plants. Diseases caused by chytrids, oomycetes, and other simple fungi include club root of cabbage, powdery scab of potatoes, potato wart, white rusts, potato late blight, and downy mildews. Diseases caused by ascomycetes and their conidial stages include the spot anthracnoses, chestnut blight, Dutch elm disease, oak wilt, ergot, brown rot of stone fruits, and innumerable others. The rusts and smuts are basidiomycetes. See DISEASES OF PLANTS.

Market produce is rotted by molds belonging in *Penicillium*, *Aspergillus*, *Rhizopus*, *Mucor*, and other genera. In forest pathology various basidiomycetes in the families Polyporaceae, Thelephoraceae, and Hydnoaceae are especially active in decaying trees, logs, and wood products. Certain ascomycetes and rust fungi cause serious forest diseases. Ascomycetes, for example, cause diseases such as chestnut blight, Dutch elm disease (q.v.), and oak wilt. Rusts long ago destroyed the entire coffee industry of Ceylon, and various rusts still threaten many economically important plants such as white pines and wheat. See ENTOMOLOGY, ECONOMIC. **FUNGICOLOUS FUNGI.** Some fungi habitually parasitize various other fungi. *Cicinnobolus* so commonly forms its flask-shaped spore fruit on conidial chains of the powdery mildews that it has been mistaken for a spore form of the mildews. *Darluca filum* forms pycnidia on fructifications of rusts. *Piptocephalis* and *Dispira cornuta* are Mucorales that parasitize other Mucorales. The truffles sometimes are parasiti-

tized by certain other ascomycetes of the genus *Cordyceps*. *Rhizoctonia solani* is said to parasitize the hyphae of certain zygomycetes, and *Fusidium parasiticum* destroys ascocarps of *Xylaria*. The so-called bubbles disease of mushrooms is caused by the deuteromycete fungus *Mycogone perniciosa*, and certain wild mushrooms are parasitized by *Hypomyces*, an ascomycete, and by *Nyctalis*, a parasitic mushroom. **PREDACIOUS FUNGI.** Some soil-inhabiting fungi trap microscopic organisms such as amoebae (see AMOEBA) and nematodes (q.v.), or eelworms. Most of these predacious fungi seem to be deuteromycetes or conidial stages of zygomycetes, but some appear to be conidial stages of basidiomycetes. Nematodes are trapped by networks of hyphae covered by an adhesive substance, by knoblike outgrowths that come into contact with the prey, or by hyphal rings which in some instances swell shut abruptly after the nematodes have entered. After an amoeba or nematode is trapped special hyphae grow into its body and deplete it of protoplasm. Predacious fungi of the genera *Zoopage*, *Stylopage*, and *Euryancale* are conidial zygomycetes. *Arthrobotrys*, *Dactylella*, and *Dactylaria* are characteristic hyphomycetes of the Deuteromycota.

Fungi and Insects. Many small animals, insects, and millipedes eat fungi and thus are instrumental in spore distribution. Some groups of insects cultivate fungi as food. Notable among these are the ambrosia beetles, tropical leaf-cutting ants, and certain groups of termites; see ANT. Fungi causing plant diseases which are disseminated by insects include the Dutch elm disease and various blue-stain fungi of the ascomycete family Ophiostomataceae. Some fungus spores, such as conidia of ergot and of the chestnut-blight fungus, and the spores of certain smuts are formed in sugary substances called honeydew, in sticky masses, or within the flowering parts of plants, and thus they come into contact with insects which then distribute them. The reproductive process of the mushroom *Coprinus lagopus* and of certain rusts depends partly on insect transmission of spermatial bodies to compatible hyphae. Numerous fungi, including *Entomophthora muscae* and other members of the order Entomophthorales, are parasites of insects. The fungus disease chalk brood of honey bees is caused by *Ascosphaera apis*. The fungi in the ascomycete order Laboulbeniales are parasites usually on the exoskeletons of arthropods, but ordinarily cause no conspicuous injury. *Septobasidium*, in the Heterobasidiomycetes, has a relationship with

scale insects that is in part parasitic, in part symbiotic. The ascomycetes *Myriangium*, *Cordyceps*, and *Hypocrella* and deuteromycetes of the genera *Beauveria*, *Cephalosporium*, *Spicaria*, *Metarrhizium*, *Isaria*, and *Hirsutella* are some common insect pathogens that may help to control insect concentrations under natural conditions.

Fungicides. To control disease-producing fungi, various organic and inorganic chemical fungicides are in common use, although concern about the harmful effects of chemical insecticides such as DDT (q.v.) is also affecting the use of fungicides; see INSECTICIDE. The chemicals are dusted or sprayed on plants or trees to kill or prevent diseases such as rusts, molds, or mildew, that can destroy whole crops. One such fungus disease caused the famous potato blight in Ireland in the early 1840's, leading to a famine in which about 1,000,000 people died. The fungicides are also used to treat seeds and soil before planting commences.

The organic fungicides are usually synthetic and include products of furfural, formaldehyde (q.v.), or other chemicals containing mercury compounds. The inorganic fungicides are obtained from compounds of metals; for example, the so-called Bordeaux mixture (q.v.) is made from copper sulfate and lime. Carbonates and chlorides are also used against mildew.

Industrial Fungi. The hydrolytic enzymes of fungi are useful for a number of industrial processes. When grown on steamed wheat bran or rice bran, *Aspergillus oryzae* produces an amylase product useful in alcoholic fermentation. Proteases obtained from *A. flavus* are used in the manufacture of liquid glue. Commercial production of industrial ethyl alcohol is accomplished by fermentation of sugarcane molasses or hydrolyzed starch by means of enzymes formed by *Saccharomyces cerevisiae*. Carbon dioxide is another product of alcoholic fermentation. In the process of bread making yeast is added to dough in order to produce this gas.

Aspergillus niger is used for the commercial production of citric acid (q.v.) and in the production of gluconic acid and of gallic acid, which is used in the manufacture of inks and dyes. Synthetic resins are manufactured from itaconic acid produced by *A. terreus* and from fumaric acid formed by the black bread mold *Rhizopus stolonifer*. Gibberellic acid, which promotes increased growth of plant cells, is formed by *Gibberella fujikuroi*, a fungus causing disease in rice plants. Commercially usable oils have been obtained from species of *Fusarium*, *Endomyces*, and other genera, and the spe-

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cies *Torulopsis utilis* is a practical source of edible proteins. Vitamin D is prepared by irradiation of ergosterol, a substance which may be obtained from the waste brewer's yeast. A yeast-like fungus called *Eremothecium ashbyii* is a source of riboflavin, and biotin accumulates during production of fumaric acid by *Rhizopus nigricans*. In the processed-food industry *Penicillium roqueforti* is used to produce Roquefort cheese and *P. camemberti* to ripen Camembert cheese.

In addition to the species useful in industrial processes, there are fungi which play a negative role, causing economic losses by attacking food products, market produce, wood products, paper, textiles, leather, paints, and optical equipment.

Medical Fungi. Fungi have been used medicinally since ancient times. The use of *Polyporus officinalis* as a purgative is no longer prevalent, but the alkaloid in the sclerotium of ergot, *Claviceps purpurea*, still is used to produce uterine contractions in childbirth. Ergot alkaloids are also a source of lysergic acid diethylamide, commonly known as LSD, which produces hallucinogenic effects, often of a severe nature; see DRUGS, ADDICTION TO. The use of antibiotics (q.v.) in medical practice dates from recognition of the antibiotic properties of penicillin (q.v.), which is obtained from growth of *Penicillium chrysogenum* in submerged liquid culture. Most of the commonly used antibiotics are produced by actinomycetes or other nonfungal microorganisms. Griseofulvin, however, is an antifungal antibiotic formed by several species of *Penicillium*. Other antibiotics, and probably some tumor-inhibiting substances, are also produced by fungi.

Many diseases are caused by fungi. Certain kinds of mushrooms (q.v.) may be poisonous. Others cause dreamlike states or conditions of emotional agitation. Spores of some fungi, prevalent in the air, cause allergic responses resembling hay fever. In addition, lesions of the body are produced by invasion and growth of certain fungi in the various tissues and organs. The superficial fungus infections, or mycoses, include the dermatomycoses, affecting the skin, hair, and nails, and also mycoses of the eyes, ears, and other exposed parts of the body. Athlete's foot, barber's itch, and ringworm are highly contagious forms of dermatomycosis, caused usually by species of *Trichophyton* or *Microsporum*. The yeastlike fungus, *Candida albicans*, and other fungi may cause either superficial or systemic infections. The latter include respiratory infections, infections of the central nervous

system, bones, lymph nodes, viscera, and all internal organs of the body. Systemic mycoses frequently affect organs that have previously become debilitated in some manner. Moniliasis, a disease caused by *Candida albicans*, often occurs in individuals suffering from some chronic illness, such as diabetes. It may be systemic, but usually is localized in the mouth, the vagina, or limited areas of the skin. Patients receiving long courses of antibiotic therapy are especially subject to superficial and systemic mycoses. Some infections of a systemic nature are acquired from contact with the fungus organisms in the soil or other natural habitats. Coccidioidomycosis, a systemic disease caused by *Coccidioides immitis*, is endemic in the southwestern U.S., where the fungus is present in the soil. Actinomycetes of the genus *Nocardia*, causing the systemic disease nocardiosis, also are found in the soil. Some other mycoses that may involve deeper organs of the body include actinomycosis, caused by *Actinomyces bovis*; North American blastomycosis, caused by *Blastomyces dermatitidis*; histoplasmosis, caused by *Histoplasma capsulatum*, and cryptococcosis, or torulosis, caused by *Cryptococcus neoformans*. Histoplasmosis, blastomycosis, coccidioidomycosis, and actinomycosis frequently are pulmonary infections resembling pneumonia and pulmonary tuberculosis.

In recent years materials called mycotoxins have been implicated as a cause of tumor formation in certain animals. One of the species that produces mycotoxins is *Aspergillus flavus*, which may occur in moldy plant materials.

P.L.L.

FUNGUS DISEASES. See FUNGI: *Medical Fungi*.

FUNK, Casimir (1884–1967), Polish biochemist, born in Warsaw, and educated at the University of Berne. He did research work in biochemistry at the Pasteur Institute, Paris; at the University of Berlin; at the Lister Institute of Preventive Medicine, London; at Cornell Medical College; and at Columbia University. He headed the biochemistry department of the State School of Hygiene, Warsaw, from 1923 to 1927. In 1936 he was appointed research consultant to the U.S. Vitamin Corp., New York City. In 1910 Funk isolated from yeast and from rice polishings a pure, crystalline chemical (now called vitamin B₁ or thiamin), the first pure vitamin (q.v.) to be prepared, and proposed the name "vitamine", later changed to "vitamin" for all such substances.

FUNK, Isaac Kauffman (1839–1912), American editor and publisher, born in Clifton, Ohio, and

educated at Wittenberg College (now Wittenberg University) and Wittenberg Theological Seminary. An ordained Lutheran minister, he held several pastorates between 1867 and 1872. Funk entered the publishing business in 1876, when he founded the firm of I. K. Funk & Company in New York City. The American publisher Adam Willis Wagnalls (q.v.) became his partner in 1877, and he joined Wagnalls in founding the Funk & Wagnalls Company in 1891. Funk also founded the *Literary Digest*, a periodical, in 1890. He was the editor of *A Standard Dictionary of the English Language* (1890-93) and chairman of the editorial board of *The Jewish Encyclopedia* (12 vol., 1901-06). Funk also wrote books and edited periodicals dealing with his four principal interests: theology, prohibition, psychic phenomena, and a system of simplified spelling.

FUNSTON, Frederick (1865-1917), American army officer, born in New Carlisle, Ohio, and educated at the University of Kansas. From 1888 to 1895 he was a field agent of the United States Department of Agriculture, serving as a member of an expedition that explored Alaska in 1893 and 1894. In 1896 he joined the insurrectionary forces in Cuba, fighting with them against the Spanish for eighteen months. In 1898, at the outbreak of the Spanish-American War (q.v.), he was appointed colonel of the Twentieth Kansas Volunteers. His regiment was not involved in any action during the war; late in 1898 it was sent to Manila in the Philippine Islands. Funston directed the regiment in operations against the Filipino nationalists led by Emilio Aguinaldo (q.v.), planning and taking part personally in the hazardous expedition that captured Aguinaldo in 1901. For this exploit he was promoted to the rank of brigadier general in the regular army.

Funston was in command of the California military department during the San Francisco earthquake and fire of 1906, and rendered invaluable assistance to the civil authorities in maintaining order after the disaster. In 1914 he was placed in command of the city of Veracruz, Mexico, after it had been occupied by American troops. He was promoted to the rank of major general later that year, and commanded the United States troops stationed in Texas near the Mexican border until his death.

FUR, soft, fine hair growing close to the hide of many mammals; see HAIR. The dressed pelts of animals, commonly referred to as furs, consist of the hide, the fur itself, and the longer and coarser guard hairs which protect the fur. Such furs are an important article of commerce used mainly in clothing and trimming. Fur has excel-

lent heat-insulating properties because of the layer of air trapped among the fibers, and, as clothing, serves a function similar to its natural use.

History. From the earliest days fur has been used as a clothing material among civilized peoples. The Chinese used fur from about 500 B.C., and fur garments were common in both Greece and Rome. In medieval times, only royalty, nobility, and certain clerics and laymen were allowed to wear fur clothing. Ermine, for example, could be used only for royal robes. In the 14th century beaver, used for making headwear, was the only fur worn by common people. The English custom of using ermine as a trimming for robes of judges has survived from the Middle Ages. Following the discovery of America furs became available to the general population for the first time; fur sources in northern Europe were so limited as to restrict the use of furs to the wealthy classes. The French settlers in Canada were especially enterprising fur traders, and the Hudson's Bay Company (q.v.), founded in 1670, spread across the continent in its search for furs. At that time furs trapped by Indian hunters could be obtained by barter at a substantial profit for the purchaser. Consequently, the fur trade was highly lucrative; among those traders whose fortunes were founded in the fur trade was the American merchant John Jacob Astor (q.v.), whose firm, the American Fur Company, was established in 1808. The fur trade became so vast that in 1947 retail sales of fur garments grossed about \$488,000,000. A decline in fur sales in the 1950's reduced the annual income of the industry to an average of \$300,000,000. The decline, however, has been reversed, and the annual income from fur sales has been rising slowly.

Fur Industry. Foxes and minks have been raised commercially over a considerable period, and fur farming has become a profitable enterprise in Canada and the United States, particularly in Alaska. About 3900 fur farms were operated in the U.S. in the late 1960's. At one time the majority of fur farms raised silver fox, which was then very expensive, but the popularity and value of this fur have greatly declined.

The main marketing centers for furs are London, New York, Montréal, and Leningrad, and the Scandinavian countries. About 80 percent of all furs are sold at public auction in free international competition. Furs are assorted in commerce on the basis of shape, size, quality, color, and special characteristics. Shape is determined by the method of removal from the carcass of the animal. Case-handled pelts are removed by



A fur merchant's store-room. Fox, mink, squirrel, muskrat, and Persian lamb, all from American fur farms, are inspected by a buyer.

Fur Information and
Fashion Council

making cuts along the insides of each of the hind legs and joining the cuts at the base of the tail. The skin is then removed by stripping it forward in the same manner as stripping off a stocking. Open-handed skins are removed by making cuts at the insides of both front and hind legs, and joining the two cuts by a long cut made from the jaw to the base of the tail.

FUR GRADES AND COLORS. The quality of pelts is usually expressed as one of four grades, called ones, twos, threes, and fours. Ones, also called primes, are furs removed at the coldest, driest time of year, when the animal is full furred. A thick, full covering causes the hair to stand erect, giving the fur a desirable, resilient quality. Twos, threes, and fours are frequently grouped as unprime pelts. Unprimes are pelts which were removed from the animal too long before or too long after it had reached prime, full-furred condition. Few pelts are absolutely without blemish. Many animals rub themselves against trees or rocks; others suffer accidents that cause damaged areas in the pelt. Such furs are identified in the trade as rubbed. Pelts may also be damaged by careless handling.

The commonest colors in furs are browns and grays. Browns are divided into five standard shades: dark, dark brown, light brown, pale, and reddish. No standard scale of shades exists for colors other than brown. The most valuable color in all furs is brown with a blue cast.

Specific qualities of certain types of pelts are used in gradation. Pelts of certain lambs and kids, for example, are graded primarily on the beauty of the hair-curling pattern when the skin is dyed, but the value of a skin used in the natural color is dependent equally on its color tone.

CLEANING AND PREPARATIONS. The preparation of

furs for the market involves a series of operations to clean and soften the pelts and enhance their beauty and durability. In addition, furs are frequently clipped, dyed, or plucked. Plucking is the process of removing the stiff guard hairs to improve the appearance and texture of fur.

The general process of cleaning and softening furs is similar to such treatment of leather (q.v.), including dampening the flesh side of the skin, kneading the skin, stretching, and cleaning it. The technique of dyeing furs has been so remarkably developed that often only experts can determine with certainty the origin of a processed fur.

Muskrat, mink, beaver, fox, and other furs are often made into coats today by being let out; in this process, each skin is cut into many strips by diagonal cuts, and the strips are then sewn together to make a longer, narrower skin than the original. The resulting garment has no visible cross seams and is more attractive.

Classification. Most classifications of furs are practical revisions of the zoological classification of mammals. The classification used in this article is as follows.

Rodents

- Water rodents
- Land rodents
 - a. Squirrel family
 - b. Rat family
 - c. Chinchilla family
 - d. Rabbit family

Carnivores

- Cat family
- Dog family
 - a. Wolf and dog group
 - b. Fox group
- Bear family
- Raccoon family

Weasel family

- a. Marten group
- b. Weasel group
- c. Large-weasel group
- Seal families

Marsupials

- Opossum

Ungulates

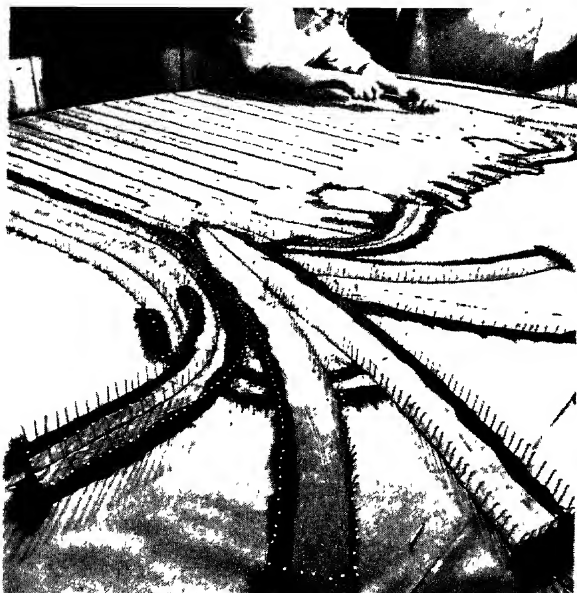
- Lamb, kid

Insectivores

- Mole

Primates

- Monkey



Fur nailer. After being wetted, skins are tacked, upside down, with thousands of nails in the position required by the pattern.

Fur Information and Fashion Council

WATER RODENTS. The principal water rodents that have useful pelts are beavers, muskrats, and nutrias. Beaver pelts are classified primarily in shades of brown. In North America, dark-brown beavers are trapped in eastern Canada, Maine, and New York; reddish beavers are trapped in British Columbia and the northwestern U.S.; and pale-brown beavers are trapped in the Rocky Mountain districts of the U.S. The fur is silky throughout in prime pelts.

Three types of muskrat are in general use: brown (or Northern) muskrat, black muskrat (actually a black phase of brown muskrat), and Southern muskrat. Prime muskrat pelts have natural luster and a full growth of fur fiber. Some muskrat pelts are greaseless and are used as natural muskrat. Both types of muskrat pelts are used to manufacture fur coats. Fine-furred muskrat originating in the northern U.S. and trapped in the spring of the year is clipped, plucked, and dyed to produce a seallike pelt called Hudson Seal. Muskrat coats are made either from the backs or from the bellies of the tanned pelts.

The coats are dyed and bleached to obtain colors ranging from light gray to dark brown.

LAND RODENTS. Nutria is the fur of a South American rodent, the coypu. The usable part of the nutria pelt is the belly; its light-brown fur is usually undyed.

Pelts of members of the Squirrel family are extensively used in Eurasia and in the U.S. The most popular furs in this group are those of the common squirrel, flying squirrel, and marmot.

The Chinchilla family includes the chinchilla

and the viscacha. The formerly scarce chinchilla is now raised on fur farms in the U.S. and in South America and it is presently available at reasonable prices. Chinchilla is used mainly for trimmings, as it is an extremely perishable fur. Good specimens of chinchilla have a slate-blue fur with a grayish middle back. The fur fibers are comparable in quality to thin silk fibers. Chinchilla pelts are less valuable when they have a yellowish tint or when the gray area is extensive. The viscacha has soft fur, gray on the back and white or yellowish on the belly. It is better known in Europe than in the U.S.

Rabbit furs are inexpensive and can be made to resemble many more expensive pelts by skillful clipping and dyeing. Rabbits used in the fur trade are obtained from almost all regions of the world. Because the thickest fur possible is preferred by the trade, pelts are obtained during the coldest months of the year.

CATS. The Cat family includes many members which have beautiful pelts, such as leopard, jaguar, ocelot, lynx, civet cat, and various kinds of wildcat. The difficulty in obtaining sizable quantities of these pelts in good condition, however, has hindered their widespread use.

DOGS The pelts of several kinds of wolf and wild dog, particularly the timber wolf and coyote, are used to a small extent in the fur trade, but the quality is poor, and these pelts are ordinarily used only for trimmings, collars, and scarves. Pale wolf furs are dyed beige or silvery gray, medium-colored furs are usually used undyed, and

Fur cutter. Long and narrow skins are needed for fur coats. In the "letting-out" process, each skin is cut into diagonal strips, which are then sewn together in invisible cross seams.

Fur Information and Fashion Council





A nutria coat in natural mutation palomino coloring.
Fur Information and Fashion Council

darker furs are dyed blue-black, brown-black, or brown.

Most fox pelts are obtained from the red fox. Black, silver, and cross foxes are melanistic color phases of red fox. The pelts are used almost exclusively as scarves or trimming. The complete scarf pelt includes the hide of the head, legs, and tail. Fox pelts are frequently dyed in colors ranging from pale tan to brown or black. Pelts to be dyed in the paler colors are bleached prior to dyeing. Fox fur, in general, has silky fur fibers, and all North American varieties except a western variety have long, silky guard hairs.

BEARS AND RACCOONS. Commercial use of pelts of members of the Bear family has never been extensive in the U.S. A small number of the smaller pelts are used for trimmings on coats, and a limited market exists in England for bear pelts used in the making of shakos. A few pelts are also marketed for use as rugs or lap robes.

Raccoon furs were formerly popular for sport coats in the U.S. Short-haired pelts are used for full-length coats because they are uniformly covered with fur. Longer-haired varieties, which have exceptionally long, silky guard hairs, are used almost exclusively for trimming cloth coats. Raccoons are sheared and dyed in brown and pastel colors to imitate beaver. The Asian raccoon, obtained from Japan, northern China, Korea, and Siberia has a naturally lighter-colored pelt than other species.

WEASELS. The Weasel family includes many of the most highly prized fur animals. The marten group consists of sables, martens, and fishers. Siberian (Russian) sable is one of the most valuable of all furs, ordinarily used only for neckpieces and stoles, or for trimming on garments made of fine karacul or broadtail. Entire garments made of sable are extremely expensive, partly because the matching of sable pelts requires inspection of a large number of good quality pelts. Fine Siberian sable furs are blue-black, with silky, lustrous guard hairs. Less desirable brown varieties lack sufficient luster and are often dyed. Marten furs are used for the same purposes as sable. Dark varieties of American marten, also called Hudson Bay or American sable, are used in the natural state; paler varieties are dyed to simulate the dark furs. Baum marten, also called pine marten, which is found in the colder districts of Europe and Russia, has a pale brown to dark blue-brown pelt with thick fur and strong silky guard hair. Baum-marten pelts are used for neckpieces and trimming. The stone-marten pelt has light gray fur contrasting richly with dark brown guard hair, and a striking white patch on the throat. It is used in its natural color and is usually made into scarves. The finest pelts of both baum and stone marten are obtained from Russia. The fisher is a close relative of the marten. Prime fisher pelts are blue-brown. So-called baby fisher is actually the soft pelt of adults of forms that inhabit eastern North America. The pelts of the western forms have rather coarse guard hairs.

The weasel group includes weasel (ermine), mink, kolinsky, and fitch. Weasel and ermine are different names for the same animal. In summer the coat of the weasel is brown, but in winter the coat turns white. The pelt taken in the winter is known as ermine. Prime ermine pelts are pure white. Pelts with yellow stains are either bleached to restore whiteness, dyed in pastel shades such as beige, or dyed to simulate brown summer-caught pelts.

Mink pelts are used extensively for making scarves, capes, stoles, jackets, and fur coats. The better varieties of wild mink have dark blue-brown short hairs with a silky texture and fine luster. Less desirable pelts are often used as trimming for garments made of lamb or seal. Farm minks of different color than the normal brown of the wild mink are called mutation minks. Careful breeding under scientific ranch conditions resulted in various mutation-mink color types, including pale brown, gray, blue, white, gun metal, and pale beige.

The kolinsky is one of the most desirable spe-

cies of Russian and Asian mink. Although similar to mink in general characteristics, its natural color is an unattractive yellow-brown, and so all pelts are dyed in varying shades of brown. A particular deep brown shade is so commonly applied to kolinsky that it has come to be called kolinsky brown. Fitch is the pelt of the ferret. The yellow fitch has yellow fur and black guard hairs. The best pelts, obtained from females, have silky guard hairs and a thickly furred neck region. Russian fitch has paler, coarser hair. Fitch pelts are used in making scarves, jackets, and muffs.

The larger-weasel group includes the otter, skunk, and badger. Otter has silky guard hairs, high luster, and rich, dark coloring. The most desirable varieties have dark brown-black guard hairs, and fur fibers that are tipped with a slightly lighter brown. The base of each fur fiber is pale gray, acting as a reflector for the tips, but the basal color does not show at the surface because of the density of the fur. Skunk is used extensively for trimmings, scarves, and muffs. The skin of a skunk pelt is light in color, in contrast to the fur; all skunk pelts are therefore dipped in a weak blue dye which stains the leather and improves the luster of the fur. Badger pelts are not valued highly; the better grades are used only for trimming.

SEALS. The seals are an aquatic group. Fur seals have a thick growth of fur fiber and guard hair. Guard hairs are removed and pelts are dyed before use. After the removal of guard hairs, the fur fibers lie flat against the leather. Fur-seal pelts are used almost exclusively for making fur coats. Hair-seal pelts are covered with guard hair only, and are used for sport coats. Fur-seal hunting is a monopoly of the U.S. government, and no seals may be hunted by private individuals for commercial purposes north of 30° latitude.

MARSUPIALS. The marsupials include the American opossum and several Australian animals. Opossum pelts are dyed and used primarily as trimming for cloth coats. A few of the choicer pelts are made into coats without previous dyeing.

SHEEP AND HORSES. The ungulates, or hoofed mammals, include lambs and kids. Popular parlance indicates much confusion in distinguishing among varieties of lamb. Karacul pelts have loose-curved, coarse, lustrous hair, usually white, black, or brown. Persian-lamb pelts have tightly-curved, coarse hairs, usually black or gray-black. Broadtail pelts, erroneously called unborn lamb, are obtained from stillborn, newborn, or very young lambs. Broadtails are never

obtained by killing ewes, for the obvious reason that this method would soon extinguish breeding stock. The hair on these pelts is too short to show much curl. Instead they display a patterned surface, called *moiré*, resulting from varying brilliancy in the reflection of light from the whorls of short hair. Persian broadtails are obtained from lambs that are a few days older than broadtails. The hair is intermediate in length between that of broadtail and that of Persian lamb or karacul. All of these lambs are varieties of a single Tibetan species of sheep. Broadtails are considered the most valuable and are exceedingly difficult to match properly. Kid pelts are used for the same purposes as the pelts of short-haired lambs. The pattern of kid fur, however, is wavy rather than curly.

Pelts of young horses, called pony, are used in making coats for women. Usable pony pelts are covered with short hairs which have a flattened, *moiré* effect. The pelts are rather stiff, and must be made supple before use. Pony is used in its natural colors, dyed black, or bleached and dyed in light shades such as beige. Pelts of adult horses cannot be used because the skin is too coarse and closely grained to be made supple enough for garments for women.

OTHER ANIMALS. Among the insectivores, the mole is the only animal that produces a commercially valuable pelt. Prime mole pelts exhibit dense growth of silky brown fur. The pelts are dipped in dye to darken them and give the fur added luster.

Pelts of a small group of African primates, the colob monkeys, are used in the fur industry. The so-called fur of these pelts is actually fine-textured, glossy hair, which is unlike the fur fibers of lower mammals. The pelts are usually cut into strips and used as trimming on coats. The skin of the pelt is light in color, and so all pelts must be dyed to avoid contrast in color between skin and air.

For further information about fur-bearing animals, see individual articles on the animals mentioned.

AMERICAN FUR MERCHANTS' ASSOCIATION
FURFURAL, or **FURFURALDEHYDE**, organic liquid aldehyde, C_4H_3OCHO , derived by steam distillation (q.v.) from corncobs, hulls, or other agricultural residues treated with dilute sulfuric acid; b.p. 161.7° C. (323.1° F.). The group of compounds related to furfural are called furans. A colorless, oily liquid in the pure state, furfural has a pungent almondlike odor and turns reddish brown upon exposure to air. It is widely used industrially as a refining solvent in the manufacture of synthetic rubber (see **RUBBER**, **SYNTHETIC**) and nylon, and in the production of

FURIES

resins for molded plastics (qq.v.) and metal coatings. It is also a component of insecticide, embalming (qq.v.) and disinfectant fluids, and certain light-sensitive furfurals are used in lithography (q.v.). See also FORMALDEHYDE.

FURIES. See ERINYES.

FURNACE, enclosed apparatus in which heat is produced, either by burning a fuel such as coal, coke, oil, or gas; by creating a resistance in an electrical conductor (induction furnace); or by nuclear fission (see NUCLEAR POWER). The amount of heat produced in a furnace can be controlled. To minimize the heat lost by radiation, the furnace is usually covered with insulation such as asbestos (q.v.) or firebrick.

Building Furnaces. Homes and many public and commercial buildings are heated by hot-air, hot-water, or steam-heating systems. The fuel is burned in a part of the furnace called the firebox and the heat rises into a combustion chamber. In a hot-air system, hot air then flows directly into insulated ducts and is distributed throughout the building; in a hot-water system, the hot air may heat water in a boiler located above the combustion chamber, and pipes then carry the hot water to and from radiators installed in the building; in steam-heating systems, pipes carrying water pass through the combustion chamber and the water is converted into steam that flows through pipes and into the radiators. See BOILER; HEATING, VENTILATING, AND AIR CONDITIONING; *Heating*.

Industrial Furnaces. Industrial processes make use of a number of different kinds of furnace. In the metallurgical industry, furnaces are used to roast and smelt ores. The blast furnace (q.v.) smelts iron ore; other types of furnace such as the basic-oxygen furnace and the open-hearth furnace convert liquid iron into liquid steel. Electric-arc furnaces are used to make high-quality steel. Shaft furnaces (cupolas) remelt iron in foundries. Volatile metals such as mercury are separated from their ores in retort furnaces. The properties of rolled or wrought metals are altered in annealing furnaces, which are also used in toughening sheet glass (see GLASS). Salt-bath furnaces are used to heat steel parts before they are hardened by rapid cooling. The ceramics industry uses a furnace called a kiln to fire products made of clay and to set glazes. Kilns are also used to calcinate limestone and in the reduction of certain ores. See also ELECTROTHERMIC FURNACE; IRON AND STEEL MANUFACTURE; METALLURGY; SOLAR POWER.

FURNESS, name of a family of distinguished American scholars. The members of the family are as follows.

William Henry Furness (1802–96), Unitarian clergyman and abolitionist, born in Boston, Mass., and educated at Harvard University. He was pastor of the First Unitarian Church in Philadelphia, Pa., from 1825 until 1875, when he became pastor emeritus. He was an early and extremely forceful opponent of the institution of slavery (see ABOLITIONISTS). He was also an early student of Jesus as an historical person as differentiated from the Christ of theology. His works include *Remarks on the Four Gospels* (1836), *A History of Jesus* (1850), and *Thoughts on the Life and Character of Jesus of Nazareth* (1859).

Horace Howard Furness (1833–1912), Shakespearean scholar, son of William Henry, born in Philadelphia, and educated at Harvard University. From 1854 to 1856 he traveled in Europe. He later studied law in Philadelphia, and was admitted to the bar in 1859. In 1866 he began the great work to which he was to devote the rest of his life: the compilation of the *New Variorum Edition of the Works of Shakespeare*, the most annotated edition of the dramatist and one of the most scholarly. The first volume, *Romeo and Juliet*, was published in 1871. Furness completed editions of thirteen additional plays before his death, including *Macbeth* (1873), *Hamlet* (2 vol., 1877), *King Lear* (1880), *Othello* (1886), and *Antony and Cleopatra* (1907).

Horace Howard Furness, Jr. (1865–1930), Shakespearean scholar, son of the preceding, born in Philadelphia, and educated at Harvard University. He began to collaborate with his father on the *Variorum Shakespeare* shortly after 1901. After the death of his father, he continued the work, editing, among other plays, *Julius Caesar* (1913) and *King John* (1919).

FURNITURE, movable articles of comfort and convenience commonly used to outfit dwellings. The term was formerly applied to such fixtures as interior woodwork, but in modern usage it applies only to movable furnishings, such as chairs, tables, and beds.

Almost every piece of furniture used today can be classified under one of five functional headings, as follows: (1) articles for rest, as chairs, stools, beds, and couches; (2) articles for work, as tables and desks; (3) articles for storage, as bureaus, bookcases, and cabinets; (4) articles for environment control, as stoves, lamps, and fans; and (5) articles for decoration, as pictures, carpets, and draperies. Furniture designers attempt to make pieces of the first four categories as decorative as possible within the limits of functional utility. The designers try to achieve this aim by employing designs and selecting materials that will harmonize with the

intended surroundings of the pieces, and by surface treatment, such as painting, staining, veneering, carving, or inlaying. Pieces of the fifth category are mainly nonutilitarian, and are prized for beauty rather than function.

Pieces of the fifth category usually are made of a wide variety of substances; and those of the fourth category are usually made of metal; furniture of the first three categories has usually been and still is made chiefly of wood.

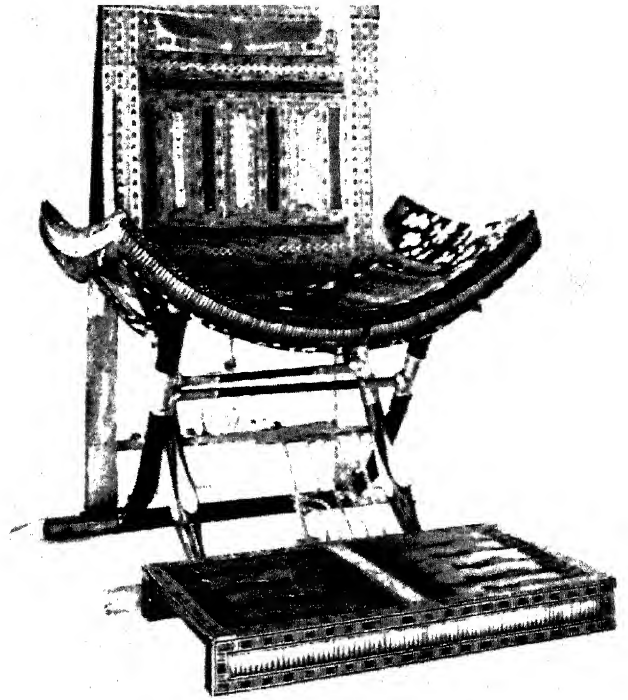
Primitive Furniture. Although little evidence exists as to the nature of the furniture of primitive peoples, it probably resembled that made by modern African and Polynesian tribes. For the most part such furniture consists of stools and headrests. The latter are usually curved pieces of wood supported either upon legs or a solid column. These primitive pieces are invariably carved from a single piece of wood.

Antique Furniture. The craftsmen of ancient Egypt made fine furniture characterized by a graceful simplicity of outline combined, particularly in religious pieces, with rich ornamentation. Because of the dry climate of the region, wood was scarce and expensive; domestic furniture was for the most part used only in the dwellings of nobles and priests. The dry climate preserves wood well; some remains are over five thousand years old.

Pictorial representations of furniture in wall paintings and papyri provide much information concerning the fine furniture of ancient Egypt. Such pieces were inlaid with silver, gold, ivory, and other valuable substances. Veneering (see *VENEER*) was also used, and designs were frequently painted on the finished wood. Animal forms, carved in the manner of the statuary of the period, adorned many chairs, couches, and tables. Many pieces of daily domestic use, such as storage chests and folding chairs and beds, were less richly ornamented, but even these were often artistically designed.

Most present knowledge of Middle Eastern furniture is based upon bas-reliefs. Such furniture seems to have been derived from the Egyptians and was inferior to it. Worthy of note is the Biblical description of King Solomon's throne "made . . . of ivory, and overlaid . . . with pure gold."

In the damp climate of Greece wood decays rapidly; the ancient furniture of that land must be judged on the representations of vase paintings and bas-reliefs. The Greek furniture-makers developed graceful abstract forms and executed them in oak, cypress, cedar, and olive, adorned with precious metals. They were fond of cushions and covered them with fine fabrics.



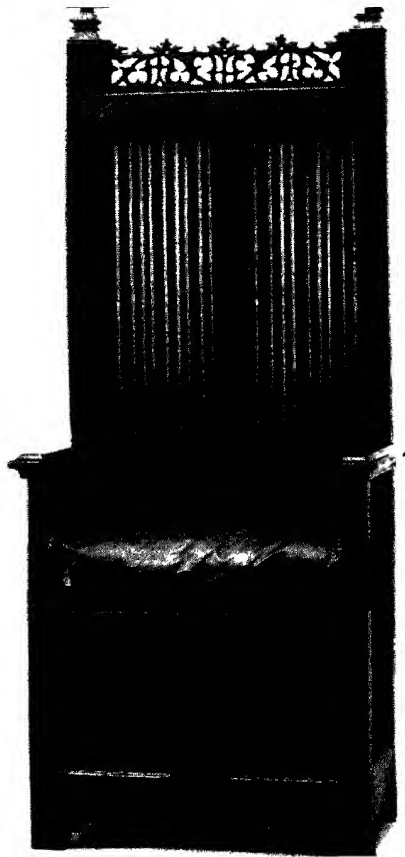
One of the many pieces of furniture found in the tomb of Tutankhamen, King of Egypt in the 14th century B.C.
Metropolitan Museum of Art

The Romans, borrowing and adapting their furniture design, as in most arts, from the Greeks, eventually evolved the Greco-Roman style, of which archeologists have uncovered many examples. Bronze was much used by Roman craftsmen, particularly in the construction of tables, chair legs, and tripods, or three-legged stands. The Romans also used marble as a material for tables and chairs. Outstanding among Roman marble furniture is a temple throne (now in the Louvre, Paris) with its seat supported by two sphinxes whose wings form its arms. Ornamentation was exceedingly elaborate in the Greco-Roman style, and the cushions of the period were even more luxurious than those of the Greeks.

After the collapse of the Western Roman Empire two styles of furniture arose, the Byzantine and the Romanesque. Both were overly ornate and showed little skill or imaginative design.

Gothic. In the 13th, 14th, and 15th centuries, preceding the Renaissance in northern Europe, the craftsmen of that region made Gothic furniture, of a new and vigorous design. The pieces were architectural in structure, small versions of the building forms of the period. In northern Europe these were the great cathedral-building centuries; and Gothic furniture, secular as well as religious, is almost entirely ecclesiastical in style, for religion then dominated all of the arts.

About 1300, Gothic artisans devised a new construction, the "panel-in-a-frame". This prin-



French 15th-century chair. Like most furniture of the period, it is made of oak.

Metropolitan Museum of Art -
Gift of J. Pierpont Morgan

ciple of using a strong skeleton and a light "filler panel" is still widely employed today not only in furniture but also in most wooden doors and shutters. The new construction enabled Gothic joiners to build storage chests of great size without undue weight, an important consideration to the seminomadic nobles and clergy of the time.

Gothic craftsmen worked chiefly in oak, and the carvers of the period, respecting the texture of the wood, raised carving to a fine art. This carved ornamentation consisted mainly of stylized representations of human beings, animals, and plants, and of geometric patterns.

Renaissance. In the early Gothic period Italian furniture-makers mixed Byzantine, Romanesque, and some details of the northern Gothic and emerged with a poor and jumbled style. In the 14th century, however, Roman art forms began to be examined with new respect and to influence furniture design.

The chair shrank from the cumbersome, ceremonial Gothic giant to a household article similar to our own; it became common, and appeared in homes that had theretofore known little or no furniture. To the wooden seat were fastened cushions that finally became uphol-

stery, or the wooden seat was replaced by leather bands.

Nobles and clergy gradually became more fixed as to residence, and the large chests with which they had formerly traveled about the country became even larger. Some were set up on legs; as the lids of these were too high to handle with ease, some anonymous designer of the Italian Renaissance set drawers into the lower part, thus producing the first chest of drawers. Other designers added arms, backs, and cushions to low chests, creating the family of settles, sofas, and settees.

Italian furniture designed in the 15th century was sparsely ornamented and restrained in character; in the 16th century, pieces became larger and more ornate, with carving supplemented by painting, gilding, and wood inlay work.

From Italy the Renaissance spread west to Spain, north to the Netherlands, England, and France, and with it went the new Italian designs in furniture.

Spanish furniture, for centuries a mixture of the dramatic Moorish techniques executed on the massive northern Gothic, was early and heavily influenced by the styles of the Italian Renaissance; it improved but little on its source.

Joiners of the Netherlands received the new ideas at second hand, through the Spanish. Grave yet rich, the style that flourished in the Netherlands for centuries is known as Flemish.

In England the Gothic spirit sturdily resisted much of the style of the Renaissance. The famous Tudor oak furniture of the time of the English monarchs Henry VIII and Elizabeth I (qq.v.), however, evidences an infiltration of the new style, indicated by ornamental details, changed shapes, and new uses. The influence of the Continent continued through the Jacobean style, and when, after the Puritan Revolution, this style was superseded by the severe, simple Cromwellian furniture, little Gothic remained in English designs.

France adopted the ideas of the designers of the Italian Renaissance with enthusiasm. Francis I (q.v.), King of France, imported Italian artisans to furnish his great châteaux. Huge ornate pieces were richly inlaid; in many cases walnut replaced the Gothic oak. Under Louis XIII (q.v.), King of France, the bourgeoisie, the merchants and shopkeepers who had not long before risen in political and economic power and now constituted the French middle class, adopted certain features of French Renaissance furniture and modified them into the simple, charming, and long-lived style named "French Provincial", which is much in vogue today.



Baroque. The Italian designers of the 17th century broke away from the regularity and comparative restraint of Renaissance line and created a new and freer school of design, the baroque. The France of Louis XIV (q.v.) accepted this novelty eagerly, and its designers, chief of whom was André Charles Boulle (1642-1732), and artisans made the splendid, preciously ornamented pieces stately and huge, hallmark of the Louis XIV style. Louis took an active interest in furniture, much of which was made in the state-controlled Gobelins factory.

The baroque movement reached England in the reign of Charles II (q.v.); there the style was called "Restoration" and featured intricate veneering and scrolled legs.

Oriental influences, imported during the great 17th-century period of European empire building, first appeared during the baroque period in such forms as imitation lacquerwork, decorated panels, and canework.

Rococo. In France, under the rule of Louis XV (q.v.), a new style involving imaginatively curved forms, the rococo, replaced the magnificent baroque. Furniture was designed unsymmetrically, executed on a smaller scale than Louis XIV pieces, and decorated extravagantly with eccentric, unbalanced representations of sea shells, animals, and flowers. Chinese influence increased; new, feminine forms such as the writing table and the chaise longue were designed. All of continental Europe adopted rococo, usually in highly exaggerated form and

Oak was a favorite material for furniture and paneling in Elizabethan times. Shown here is the Carved Oak Room from the William Crowe House, Great Yarmouth, Norfolk, England.

Metropolitan Museum of Art

with consequent degeneration of the style into overornamented grotesqueness.

Louis XVI. The undisciplined fancy of the rococo was rejected in a return to classic forms under Louis XVI (q.v.) of France. Archeologists excavating at Pompeii and Herculaneum uncovered remains of Greco-Roman furniture, and French designers copied the ancient models carefully. The style is austere and graceful. Directoire, a style designed immediately following the French Revolution, was a simplification of Louis XVI style to please more democratic tastes.

Empire. The artists who designed the furniture of the Empire style for Napoleon I (q.v.), Emperor of France, borrowed heavily from ancient Egyptian, Greek, and Roman models, producing massive, powerful forms, executed in mahogany, rosewood, or ebony. Ornamentation was simple, veneering and inlay work being used for relief. Upholstery fabrics were heavy and rich.

As Napoleon conquered most of Europe, his Empire style was adapted by designers in the states he conquered, thus producing the neo-classic style of northern Italy and the Biedermeier school of Austria and Germany.

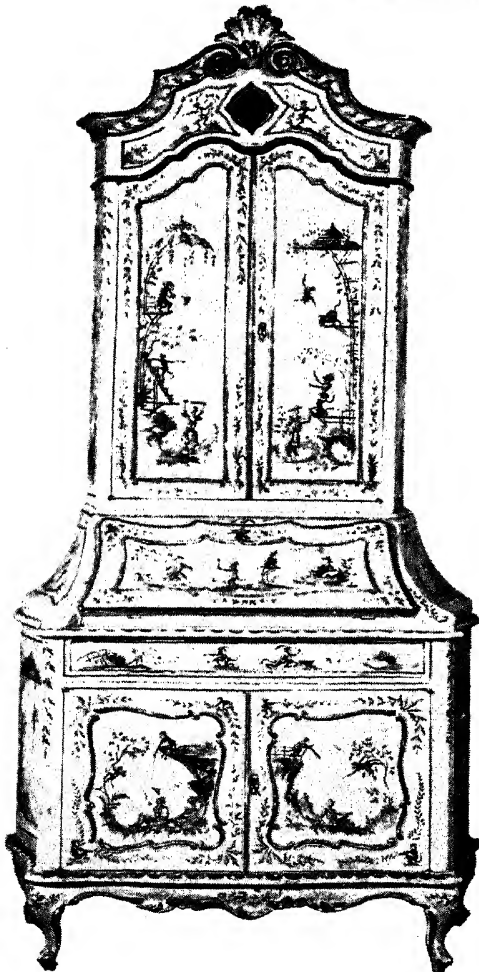
18th-Century England. The baroque style of Restoration furniture was sharply modified, brought down from the monumental and formal to the graceful and comfortable by Dutch influ-

FURNITURE

ence during the reigns of the English monarchs William III, Mary II, and Anne (q.v.). This major design, imported from the Continent, was the last that England was to borrow; thereafter, English designers remained almost exclusively in their own great tradition, in the line that, starting with English Gothic, resisted foreign influences and maintained a distinct individuality.

While the rococo style was flourishing in France and the rest of the Continent, English artists were designing the first examples of Georgian furniture. Although this important period of English furniture-making is named after the British Hanoverian monarchs of the time, they did not affect form as had their predecessors, the Tudors and the Stuarts, and as had the Bourbons in France; the greatness of English 18th-century furniture is due entirely to the artistry of William Chambers (1726–96), William Halfpenny (fl. 1752), and Robert Manwaring (fl.

Painted Venetian secretary-cabinet of the 18th century.
Parke-Bernet Galleries



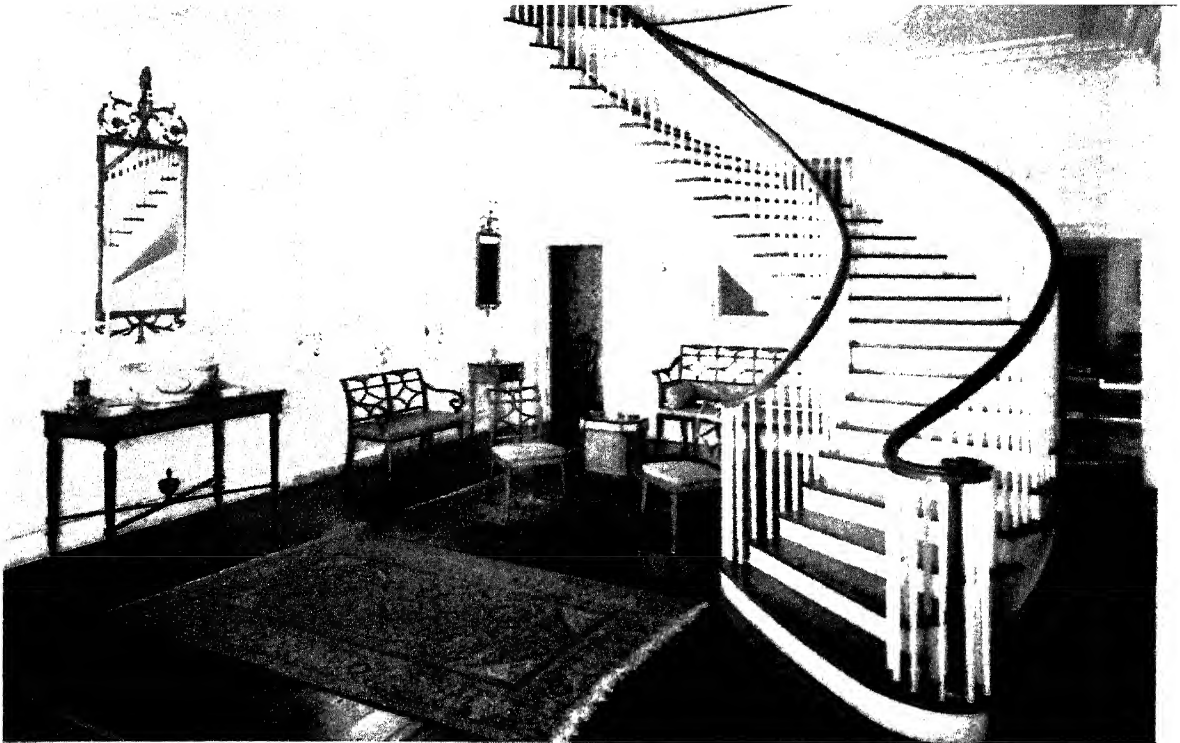
1760), and to the genius of such masters as Thomas Chippendale, Robert Adam, George Hepplewhite, and Thomas Sheraton (qq.v.).

Chippendale employed baroque as a foundation upon which he built in Gothic, rococo, or Chinese styles, according to the fancy of his client. He collaborated with Robert Adam and other great designers of the period, executing the designs in his own shops. Among his most important contributions are his books, primarily *The Gentleman and Cabinet-Maker's Director* (1754), which influenced design not only in England but also in the colonies.

Unlike Continental designers, English designers had never departed from the classic line. Among the purest of the English classicists were Adam and his brothers, architects who designed their buildings completely furnished. Stricter than Chippendale, they eschewed much of baroque and even the fragments of rococo that he had used, depending solely upon the clean, spare lines of antiquity. Hepplewhite and Sheraton balanced each other on the seesaw of taste; Hepplewhite at first let his designs be influenced by Continental tastes, but later liberated himself and worked in the classic vein; Sheraton's early work resembled the pleasing antique copywork of the Louis XIV style; his later work shows nonclassic influences. The furniture of 18th-century England is characterized by grace, lightness, and simplicity. The favorite wood of the period was mahogany.

The 18th-century style continued to be used in England throughout the following century. Furniture design consisted for the most part of increasingly convoluted copies of earlier work, the only exceptions being the work produced in England by William Morris (q.v.) and his associates.

American. Most of the early American colonists came from England, and furniture of the colonial period was derived mainly from English styles. Because of the austerity of living conditions, much of the furniture made in the colonies during the late 17th and the early 18th century was simple, often crude, and lacking in decoration. Many New England pieces were made of pine, a wood readily obtainable and sufficiently soft to be easily worked. Later, as the colonies became more settled and prosperous, furniture from the Old World was imported and the styles popular in contemporary England were reproduced in American homes, particularly in well-established communities in Massachusetts and Virginia. In New York and Pennsylvania the Dutch and German colonists contributed to a native colonial style. Throughout



the middle Atlantic seaboard colonies developed a style known as Pennsylvania Dutch, which was unique in its use of stylized decorative animal and plant motifs painted on simple wooden furniture, often massive, and on household articles.

After the American Revolution, first the Federal style and then the American Empire, or Neoclassic, style were popular in the United States. Both of these styles were direct reflections of the work of European designers. Even the great Duncan Phyfe (q.v.), justly celebrated for his taste and craftsmanship, derived his designs from European forms.

Furniture in the East. The development of furniture in the East was slower than in Europe. Until recent times Oriental peoples were accustomed to sitting cross-legged upon the floor or ground, instead of using chairs. Also, climatic conditions led them to spend much time out of doors, in gardens and courts in which furniture was little used. The houses of Muslim people have always been largely furnished with carpets and draperies. Persian miniatures of the 17th and 18th centuries show the inhabitants of houses seated upon elaborate carpets before low, simple tables. Such furniture as survives from this period consists of small polygonal tables, cabinets, and boxes, usually made of hardwood with inlaid geometrical designs in ivory and mother-of-pearl. Indian furniture, which did not develop until the 18th century, closely resembles that of Persia. In the early 19th

This installation of an elegantly curving stairway moved from a North Carolina residence of the early 19th century, recreates the flavor of the period. The furniture groupings, which all show English influence, include a pier table (front) by the French cabinetmaker Charles-Honoré Lannuier, who worked in New York City (1803-19) and other pieces attributed to John Seymour and his son Thomas, cabinetmakers at Boston (about 1794-1804).

Gilbert Ask - Henry Francis du Pont Winterthur Museum

century, the use of rich openwork carving on the doors of cabinets was common.

In China the making of elaborate furniture did not begin until the early part of the 17th century. The first furniture of the period consisted of low stools and tables, which are distinguished by legs that curve inward at the bottom, often with a trellis-work of supports between the legs and the underframe. Supports such as these, and elaborate lattice-work in all open spaces, are structurally typical of Chinese furniture, and are especially noticeable in the carved vase-stands, or *étagères*, of the Ming period, in the 17th and 18th centuries. All formal furniture was lacquered, in the early period with gold upon black, with intricate designs inlaid in mother-of-pearl. Colored lacquer work upon coromandel wood appeared at the end of the 17th century. The cheapest and lightest Chinese furniture was constructed of bamboo, with rosewood, ebony, and other expensive woods being used for more elaborate pieces. The Chinese method of constructing furniture with complex supports and carved trellis-work influenced the design of much European furniture of the 18th century.

FURNITURE

The furniture of Japan, which until recent years was not as elaborate as that of China, is particularly notable for its small movable pieces, such as the decorated folding screens with from two to six panels, and the small lacquered cabinets, which were used to hold gems and small objects carved in ivory.

Modern Furniture. Although traditional period furniture remained popular in the 20th century, and fine reproductions of early pieces were made, a new style, known as modern, began to develop shortly before World War I. From about 1910, architects and furniture designers began using new materials such as steel and aluminum. They also employed conventional materials, such as glass, in distinctive ways. With these developments, there grew up the theory of functionalism. The functionalists believed that an article must be designed and made so that it can best fulfill its intended purpose. The general trend of the period was toward simplicity of form and the elimination of superficial ornamentation. Two distinct schools composed the modern period in furniture designing.

The first, which developed under the influence of the Hungarian architect Marcel Lajos Breuer (q.v.), onetime director of the Bauhaus at Dessau, employed bent steel and aluminum tubing for the framework of furniture, and webbing or leather strips for the seats and backs of chairs. Many 20th-century architects, such as Le Corbusier, Walter Gropius, and Frank Lloyd

Wright (qq.v.), designed furniture for the houses built under their direction.

The other school, led in its early days by the Finnish architect Alvar Aalto (1898–), developed in the Scandinavian countries; it made use of plywood, which bent with the aid of steam into a variety of shapes that made one-piece furniture practicable at low prices.

The use of plywood and common lumber for furniture of modern style was adopted by American designers. Because of the simplicity of its design, this type of furniture was well-adapted for mass production. See articles on many of the styles mentioned and on individual pieces of furniture. See also INTERIOR DECORATION.

FÜRTH, city of West Germany, in Bavaria State, at the junction of the Pegnitz and Rednitz rivers, about 100 miles N.W. of Munich. Industries in the city are the manufacture of toys, mirrors, wearing apparel, paper, and pencils. Fürth is a trade center for the coal, metal, hops, and wool of the surrounding region, and an annual fair is held at Michaelmas (Sept. 29). Notable buildings in Fürth are Saint Michael's Church, constructed during the 14th century, and the 19th-century town hall, with a 175-ft. tower. Reputedly founded by Charlemagne (q.v.), Holy Roman Emperor, Fürth was for a time in the possession of the burgraves of Nuremberg and later of the archbishopric of Bamberg; it was acquired by Bavaria in 1806. In 1835 the city became the terminal of the first railroad built in Germany, from Nuremberg to Fürth, a distance of 5 mi. During World War II Fürth sustained heavy damage from Allied air raids; it was later part of the United States zone of occupation. Pop. (1970) 94,400.

This modern living-dining room, designed by Danish interior decorators, emphasizes contrast by the use of rosewood and steel, a multicolored rug, and stark white walls.

Bloomington's, New York



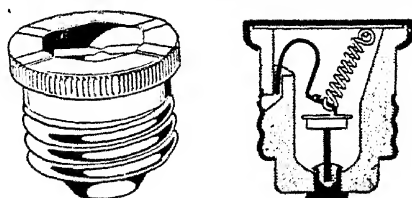
FURZE, or **GORSE** or **WHIN**, common name of any plant of the genera *Ulex* and *Genista* belonging to the Pulse family Leguminosae. Common furze, *U. europaeus*, is native to Great Britain and western Europe. It is a thorny evergreen shrub with sharply pointed leaves, and solitary flowers having a two-lipped, shaggy, deep yellow calyx subtended by two small bracts. The fruit is a pod. In mild climates the flower blooms all winter. In its natural state furze provides food for sheep; after the spines are removed, the shoots provide winter fodder for horses and cattle. Furze is sometimes planted as a sand binder, and *U. europaeus*, introduced to the eastern coast of the United States from Nantucket to Virginia, serves in this capacity. Seeds of *U. europaeus* yield the poisonous alkaloid ulexine, $C_{11}H_{14}N_2O$, formerly used as a local anesthetic and diuretic.

FUSAN. See **PUSAN**.

FUSE, safety device used to protect an electrical circuit from the effect of excessive current. Its essential component is usually a strip of metal that will melt at a given temperature. A fuse is so designed that the strip of metal can easily be placed in the electrical circuit. If the current in the circuit exceeds a predetermined value, the fusible metal will melt and thus break or open the circuit.

Devices used to detonate explosives (q.v.) are called fuzes; see **FUZE**.

Two types of fuses are commonly used, cylindrical fuses and plug fuses. A cylindrical fuse consists of a ribbon of fusible metal enclosed in a ceramic or fiber cylinder. Metal end caps fastened over the cylinder make contact with the metal ribbon. This type of fuse is placed in an electrical circuit so that the current must flow

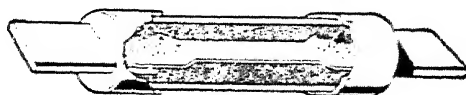


Left: Ordinary plug fuse. Right: Fusetron dual-element plug fuse.

through the metal strip to complete the circuit. If excess current surges through the circuit, the metal link will heat to its melting point and break. This action will open the circuit, stop the current flow, and thus protect the circuit. The cylindrical type of fuse is most used to protect electrical equipment and appliances.

Plug fuses are commonly used to protect electric wiring in homes. This type also employs a

fusible metal strip through which the current must flow to complete the circuit. The strip is, however, enclosed in a plug that can be screwed into an ordinary electric receptacle or light socket. Plug fuses usually have a mica window at the base of the plug so that the condition of the metal strip can be seen at a glance.



Cutaway view of an ordinary one-time fuse.

Recent fuse developments include types that will permit a momentary overload without breaking the circuit. These are necessary for circuits that are used to power air conditioners or electric broilers, because initial surges of power can be expected with such appliances. Another recently developed type of fuse contains several links that can be selected by the flip of a switch. If the fuse is "blown", another link can be switched in without replacing the fuse.

In high-voltage circuits, subject to frequent interruptions, protection is given by circuit breakers rather than by fuses; see **ELECTRIC-POWER SYSTEMS**.

FUSE, suburban industrial city of Japan, now part of Higashiosaka, in Osaka Prefecture, on S.E. Honshu Island, adjoining the city of Osaka on the E. A rail junction on the Katamachi line and also a road junction, the city has engineering plants and manufactures chemicals, metal and rubber products, pharmaceuticals, plastics, and pottery. Pop. (1966 est.) 253,000.

FUSELAGE. See **AIRPLANE: Airplane Structure: Fuselage**.

FUSHUN, city of China, in Liaoning Province, 28 miles E. of Mukden. The neighboring area contains the richest coal beds of China. Thick deposits of oil shale lie over the coal. In the city coal and oil are processed, and fine steel, aluminum, heavy machinery, and electrical equipment are produced. Fushun is also the center for an agricultural area producing soybeans, wheat, millet, sorghum, corn, cotton, sugar beets, rice, and tobacco. Pop. (1970 est.) 1,700,000.

FUSIN, or **FUHSIN**, city of China, in Liaoning Province, about 90 miles N.W. of Mukden. A major coal-mining center, Fusin is said to have the largest coal reserves in the historic region of Manchuria (q.v.). The surrounding area produces soybeans and grains. The municipality was in the former Jehol and Liaosi provinces intermittently from 1914 to 1956, and in Japanese-controlled Manchukuo from 1932 to 1945; see

FUSION

MANCHURIA. The name is sometimes spelled Fuhsin, Fowsin, and Fou-hsin. Pop. (1970 est.) 350,000.

FUSION, change of a substance from the solid to the liquid state, usually by the application of heat. The process of fusion is the same as melting, but the term "fusion" is usually applied to substances such as metals which become liquid at high temperatures, and to crystalline solids. When a substance is at its melting or fusing temperature additional heat is absorbed by the substance in changing its state without raising its temperature. This additional heat is known as the heat of fusion; see FREEZING POINT; HEAT. The term "fusion" applies also to the process of heating a mixture of solids to give a single liquid solution, as in the formation of alloys. For nuclear fusion, see ATOM AND ATOMIC THEORY; NUCLEAR ENERGY; NUCLEAR WEAPONS.

FUST, Johann or FAUST, Johann (about 1400–66), German moneylender and printer, born in Mainz. In 1450 Fust lent about 800 gulden to the printer Johann Gutenberg (q.v.), with which Gutenberg was supposed to make "tools" for his press, then still in an experimental stage. Two years later Fust advanced another 800 gulden to Gutenberg. Failing to recover his money, Fust brought suit, claiming the then-secret machinery of the press against the debt. The disposal of the disputed machinery is unclear but Fust seems to have obtained a part of the press as he subsequently published books in his own house, in partnership with his son-in-law Peter Schöffer (1425?–1502?). The psalter they printed on Aug. 14, 1457, is the first printed book with a date and with a complete colophon, or identifying device of the printer. It is a folio of 350 pages, with blue and red initial letters, printed by means of two-piece type. After the seizure of Mainz in 1462 by Adolf of Nassau, archbishop of Mainz (d. 1475), Fust's printing shop was forced to suspend operations until 1465. During this period of unrest the secret of printing became common property. Fust and Schöffer also printed, in 1462, a *Biblia Sacra Latina*, or Holy Bible in Latin, in two volumes of 242 and 239 leaves respectively; and, in 1465, *De Officiis* ("On Moral Obligations") by the Roman statesman Marcus Tullius Cicero (q.v.). This interleaved quarto of 88 leaves was the first printed edition of a Latin classic and contained the first printed Greek characters. See also GUTENBERG BIBLE.

FUSTIC, common tropical American tree *Chlorophora tinctoria*, belonging to the Mulberry family Moraceae, or a dye derived from the wood of the tree. The colors imparted by the

dye are products of the action of mordants on two colorless compounds, morin, $C_{15}H_{10}O_7$, and maclurin, $C_{13}H_{10}O_6$. Fustic has been used as a component of wool dyes, for the production of olive and brown tints, and for reducing the intensity of blacks but has been largely supplanted by synthetic yellow dyes. Young fustic, or fustet, is an orange dye derived from the wood of the European smoke tree, *Rhus cotinus*. The common name of the latter dye arose from the false assumption that smoke-tree wood comes from immature fustic trees.

FUSUS (Lat., "spindle"), genus of marine snails of the suborder Neogastropoda, commonly called spindle shell. Their name derives from the shape of their thin shell, which swells from the convoluted conical apex into a rounded central portion which narrows into a long canal, leading from the mouth and containing the siphon. The genus is widely distributed and dates from the Cretaceous Period (q.v.). *Fusus antiquus* is called the hard whelk by British fishermen, and is caught for food and for its shell, which is prized by collectors; *F. proboscoidalis* is one of the largest species.

See GASTROPODA; WHELK.

FUTURE FARMERS OF AMERICA. See AGRICULTURAL EDUCATION.

FUTURE HOMEMAKERS OF AMERICA, national nonprofit youth organization, founded in 1945, operating through the secondary schools for students taking courses in home economics (q.v.) and related occupations. There are two chapters: the F.H.A. chapters emphasize individual homemaking and exploration of careers in home economics; the HERO chapters stress preparation for careers in specific occupational areas.

The organization is headed by a national executive council, composed of twelve students elected annually as national officers and three national HERO representatives. A board of directors, including ten adult home economists and two youth representatives, serves as the governing body. The organization, with headquarters in Washington, D.C., is cosponsored by the Division of Vocational and Technical Education, the United States Office of Education, and by the American Home Economics Association. Its official magazine, *Teen Times*, is published four times during the school year.

In 1973 the organization had about 500,000 members in 11,000 local chapters, and 52 State associations in the U.S., Puerto Rico, the Virgin Islands, and American schools overseas.

FUTURISM, early 20th-century movement in art and literature that pointedly rejected all tra-

ditions from the past and attempted instead only to glorify contemporary life mainly by emphasizing its two dominant themes, the machine and motion. The principles of futurism were originated by the Italian poet Filippo Tommaso Marinetti (1876–1944) and published by him in a manifesto in 1909. The following year the Italian artists Giacomo Balla (1871–1958), Umberto Boccioni (1882–1916), Carlo Carrà (1881–1966), Luigi Russolo (1885–), and Gino Severini (1883–1966) signed the *Technical Manifesto of Futurist Painting*. As an art movement, futurism was characterized by the attempted depiction of several successive actions of positions of a subject at the same time. The result resembled somewhat a stroboscopic photograph or a high-speed series of photographs printed on a single plate. Interesting examples are Severini's "Dynamic Hieroglyphic of the Bal Tabarin" (1912, Museum of Modern Art, New York City) and his "Armored Train" (1915, Collection Richard S. Zeisler, New York City). Although the futurism movement was short-lived, lasting only until about 1914, its influence can be seen in the works of painters Marcel Duchamp, Fernand Léger (qq.v.), and Roger Delauney (1885–1941) in Paris, and the Constructivists in Russia. The futurist worship of the machine survived as a fundamental part of fascist doctrine.

FUZE, device used to trigger the detonation of an explosive charge. Two general categories of fuzes are recognized: those used to set off explosive charges in mining, quarrying, and blasting; and military fuzes, used to detonate bombs, shells, rockets, and depth charges.

The use of fuzes in blasting operations (in this sense, fuze may often be spelled *fuse*) is chiefly a safety measure, to enable the operator to detonate a charge from a distance. Two kinds of fuzes are in common use for this purpose. Trains of black powder wrapped in tape or contained in a hollow cord burn at a steady, predetermined rate, slowly enough to allow the operator to reach a place of safety before the flame reaches and sets off the charge. For many blasting and mining operations, however, electrical fuzes are preferred. These are simply lengths of double wire through which a current is passed to an electric detonator located at the charge. The current source is normally a hand-operated generator or magneto.

A military fuze is designed to detonate an explosive charge when the charge is within damaging range of a particular target. A projectile fuze (that is, one attached to a bomb or shell) may be designed to detonate the charge at



The futuristic movement is exemplified by the painting "Dog on a Leash" by Giacomo Balla.

Museum of Modern Art—A. Conger Goodyear Collection

some predetermined time after the projectile strikes a target. For other applications, a fuze may explode a projectile when the projectile reaches a given speed or a predetermined depth in water, or the fuze may respond to some form of radiation from a target.

The designer of military fuzes must consider a number of factors. He must not only provide means for setting off the fuze at the proper moment, but must also make the fuze and its projectile safe before and during firing. Furthermore, fuzes for shells fired from guns and rocket launchers must be capable of withstanding the tremendous strains or setbacks at the time of firing, as well as the great centrifugal forces set up by the rapid spin of shells fired from rifled artillery.

Shell Fuzes. A variety of fuzes for many types of artillery shells were developed and manufactured by all combatant nations in World War II. Three different types are described here.

A typical base-detonating fuze, used in high-explosive antitank projectiles, has a firing pin at the rear of the fuze that is normally locked by a pair of spring-loaded pins. As the shell starts down the barrel and begins to revolve at more than 1700 revolutions per minute, centrifugal force moves these pins out of the way. As the shell progresses further down the barrel and rotates at about 3000 revolutions per minute, a metal slider, which until that time had constituted a barrier or *break* in the column of explosive inside the fuze, is similarly moved out of the way, and the fuze is *armed* and ready to

FUZE

detonate. When the shell hits its target, the inertia of the firing pin causes it to strike a primer that initiates the detonation. Chemical or mechanical devices are sometimes used to delay detonation for a short time after impact.

The mechanical nose fuze of a shell, which is intended to detonate at a preset time of up to thirty seconds after the shell is fired, operates on the clockwork principle. This fuze contains a gear train (see **GEARING**) that is actuated by a pair of weighted gear segments that are put in motion by centrifugal force. The gear train drives a timing disk that is set in position before the shell is loaded in the gun. When the timing disk has revolved for the proper length of time, a notch in its disk releases a spring-driven firing pin, detonating the fuze. Three separate locking devices, two operated by the setback of firing and one by centrifugal force, insure the safety of the fuze. See **SHELL**.

Bomb Fuzes. Fuzes used on aerial bombs employ impact-detonating and time-detonating devices that are very similar to those used on shells. The only basic difference between fuzes of these two types is in the methods used to arm them. Bomb fuzes are armed in one of two ways: either by withdrawing a locking pin before the bomb is released or by the use of an arming vane, a small propeller that spins as the bomb falls through the air, opening a locking device within the fuze. Depth bombs used in antisubmarine warfare have fuzes that are actuated by hydrostatic pressure on a diaphragm within the fuze. Such a fuze can be set to detonate at a given depth by the use of springs of different strengths working against the diaphragm.

Proximity Fuze. The variable time (V.T.), or proximity, fuze developed in World War II is one of the most effective of all fuzes because it can detonate within effective range of its target without depending on either contact or elapsed time. It is essentially a radar (q.v.) device comprising an exceptionally small and exceptionally sturdy radio transmitter and receiver. The transmitter sends out a continuous signal, which is reflected back to the receiver by any object within the lethal range of the shell or bomb to which the fuze is fitted.

When the receiver picks up the reflected signal, it operates an electronic switching device, detonating the fuze. The development of this type of fuze was a technological triumph,

achieved by cooperative efforts of British and American scientists in the early phases of World War II. It involved the design of vacuum tubes and other components to withstand accelerations as great as 20,000 times that of gravity. Proximity fuzes were effective both in anti-aircraft fire and also in ground-artillery fire against troops in protected positions.

For detonation devices in nuclear weapons, see **NUCLEAR WEAPONS**. For safety fuses, see **FUSE**.
R.A.W.-W.

FYLFOT. See **SWASTIKA**.

FYN (Ger. *Fünen*), one of the islands of Denmark, separated from the Jutland Peninsula on the w. by the Lille Bælt (Little Belt) channel, and from the island of Sjælland (Zealand) on the e. by the Store Bælt (Great Belt) channel. The surface of Fyn is slightly elevated in the s. and in the w., rising to more than 400 ft. above sea level. The terrain in the n. and in the e. is level, with notably fertile soil. Cereal grains are raised, considerable amounts being exported, and livestock raising is carried on extensively. Together with several nearby smaller islands, Fyn forms a county of the same name. The principal towns on Fyn are Odense (q.v.) and Svendborg. Area, 1149 sq.mi.; pop. (1972) 436,469.

FYT, Jan (1611–61), Flemish painter and etcher of animals and still life, born in Antwerp (now in Belgium). He studied principally with Frans Snyder (q.v.), the greatest of Flemish animal and still-life painters. Fyt received early recognition, entering the painters' guild of Saint Luke, Antwerp, as a master painter at the age of twenty. From 1631 to 1641 he studied and worked in Italy; in 1652 he became dean of the painters' association known as the Guild of the Romanticists, Antwerp. Fyt produced a great number of pictures, using as subjects all types of birds and animals; he was particularly skillful in painting dogs. His paintings are characterized by extreme realism in the depiction of the textures of the fur of animals and the plumage of birds, as well as by harmonious color and, frequently, bold and dramatic action. He had difficulty, however, in painting the human form and architectural backgrounds, and sometimes left these features to other artists. Fyt's pictures are part of the permanent collections of many museums, including the Metropolitan Museum of Art in New York City, which has the paintings "Dead Game" and "Dead Hare and Birds".

FYZABAD. See **FAIZABAD**.

Gg

G, seventh letter in the English and other alphabets derived from the Latin. The uppercase, or capital, G is derived from the Latin C, which in turn is from the Greek Γ, *gamma*, rounded in the 7th century B.C. Latin c represented the sounds of both *g* and *k* until the 3rd century B.C., when the character was modified to make a distinction of the *g* sound (see article on letter C). Once established, the new letter took the place in the alphabet of the Greek Ζ, *zeta*, which was not used in Latin. The modern lowercase *g* developed gradually from a form that had appeared at the beginning of the 7th century A.D.

The sound represented by *g* was universally velar, that is, the sound of the so-called hard *g*, in both Latin and Old English. In Late Latin it changed into a *y* sound before *e* and *i*; in the later development of the Romance languages (q.v.) this sound changed into that represented by the *g* in the Italian word *generale* (phonetically, dʒ); still later it was modified in French to the *g* of *général* (ʒ), and in Spanish to the *g* of *general* (x). In the transition from Old English to Middle English, *g* became *y* in certain positions, notably in the initial position before *e*. Thus, the participial prefix *ge* became *y*, as in *yclept*, and then disappeared. In words such as *yard* (O.E. *geard*) and *yellow* (O.E. *geolu*), the *y* was retained. In other positions, notably the final position and in some *ng* groups, *g* acquired the sound of *j*, as in *bridge* (O.E. *brycg*) and *singe* (O.E. *sengan*).

In physics the capital G stands for the gravitation constant and conductance. A lowercase *g* represents, in weights and measures, gram; in physics and engineering, gravity and the electromagnetic unit called the gilbert; in aeronautics, acceleration due to gravity; and in psychology, general intelligence.

As a symbol, G in music is the fifth tone of the natural diatonic scale of C, and in the treble clef (also known as the G clef), it is written on the

second line and in the first space above the staff; in the bass clef it stands on the first line and in the fourth space. In spectroscopy, G represents a line in the spectrum caused by iron (see FRAUNHOFER LINES).

As a medieval Roman numeral, capital G denoted 400 and, in the form Ġ, 400,000. **M.P. GABBRO**, general name for a large group of granular igneous rocks, composed of plagioclase feldspar with a predominance of dark minerals, usually pyroxene, hornblende, or olivine (qq.v.). The rocks are heavy, often greenish in color. Gabbros occur in the Adirondack Mts., in the vicinity of Baltimore, Md., and in the highlands along the north shore of Lake Superior from Duluth, Minn., to the Canadian border.

GABIN, Jean (1904–76), French motion-picture actor, born Jean Alexis Monçorgé in Paris. The son of a theatrical family, Gabin appeared at the Folies Bergères in Paris and in cabarets, vaudeville, and the legitimate theater before 1930, when he appeared in the first of scores of films. Julien Duvivier (1896–1967), noted French film director, cast Gabin in *Maria Chapdelaine* (1931; United States release 1935), which made him a star. Duvivier also directed Gabin in *Pépé le Moko* (1937; U.S. release 1941). Gabin's distinctive tough-but-gentle naturalistic characterization was established in this film. Other important films in which Gabin starred include *Grande Illusion* (U.S. release, *Grand Illusion*, 1937) and *Le Jour Se Lève* (U.S. release, *Daybreak*, 1939). Gabin served in the French navy in World War II until the fall of France in 1940. He then came to the U.S., where he made two films. He later fought with the French Resistance forces. During the last twenty-five years, Gabin has made about two dozen films, among the latest of which are *Crime et Châtiment* (1956; U.S. release, *The Most Dangerous Sin*, 1958), *Un Singe en Hiver* (1962; U.S. release, *Monkey in Winter*, 1963), and *Le Clan des Sicil-*



Clark Gable and costar Claudette Colbert try to thumb a ride in a scene from the 1934 comedy classic *It Happened One Night*. UPI

iens (1969; U.S. release, *The Sicilian Clan*, 1970).

GABIROL. See IBN-GABIROL, SOLOMON BEN JUDAH.

GABLE, (William) Clark (1901–60), American motion-picture actor, born in Cadiz, Ohio. Before achieving fame in motion pictures, Gable performed a wide variety of jobs, from drilling oil wells to playing minor parts in silent films. He made a successful Broadway appearance in an important role in *Machinal* (1928). The first film in which he was featured was *The Painted Desert* (1931). During the 1930's Gable was the outstanding leading man in American films; he played opposite the best-known actresses of the time, and was frequently cited as the personality whose films made the most money at the box office. In motion pictures such as *It Happened One Night* (1934), for which Gable won the best-actor award of the Academy of Motion Picture Arts and Sciences, *Mutiny on the Bounty* (1935), and *Gone with the Wind* (1939), he played a role that was the prototype of the virile, adventurous American male. Gable served as a combat gunner in World War II from 1942 until his discharge with the rank of major in 1945. After the war Gable returned to the screen in such films as *Command Decision* (1949), *Across the Wide Missouri* (1951), and *Mogambo*

(1953). He died a few days after completing his last film, *The Misfits*.

GABON REPUBLIC, independent nation in w. central Africa, bounded on the N.W. by Equatorial Guinea, on the N. by Cameroon, on the E. and S. by the Republic of Congo, and on the W. by the Atlantic Ocean. The country lies between about lat. 2° N. and lat. 3° S. and long. 9° E. and long. 14° E. The area of Gabon is about 102,000 sq.mi.

THE LAND

The coastal lowlands range from 20 mi. to 125 mi. in width. Beyond this region is the plateau zone that extends over the entire N. and E. sections of Gabon and part of the S. The Crystal Mts. in the N. are about 3000 ft. high. The central Chaillu Mts. contain Mt. Ibounzi (5165 ft.), the highest summit in the country. The escarpment is crossed by numerous rivers, notably the Ogooué R., which empties into the Atlantic Ocean. Virtually the entire country is contained in the basin of the Ogooué R., which is over 500 mi. long and navigable for 150 mi. from the Atlantic Ocean. The country is covered almost entirely by a dense equatorial rain forest.

Climate. Gabon has a hot and humid climate. The temperature varies only slightly throughout

the year. The average daily temperature is 80° F. From June to September virtually no rain falls but humidity is high. In December and January the rainfall is slight. During the remaining months rainfall is heavy. At Libreville, the capital, the average annual rainfall is more than 100 in.; on the N.W. coast it is 150 in.

Natural Resources. The principal resources of Gabon are mineral. Gabon has deposits of uranium, manganese, and oil, all of which are being exploited; large deposits of iron ore, considered among the richest in the world, are scheduled to be mined. In the past, gold and diamonds were exported in large quantities, but recent production has been small because the supply of these minerals is nearing exhaustion. Lead and silver ores have been discovered. Gabon also has valuable forest resources, mainly in its stands of okoumé, mahogany, kevazingo, and ebony.

Production of electric energy in the mid-1970's was approximately 228,000,000 kw hours annually. A hydroelectric plant is at the Kinguele Falls in Libreville.

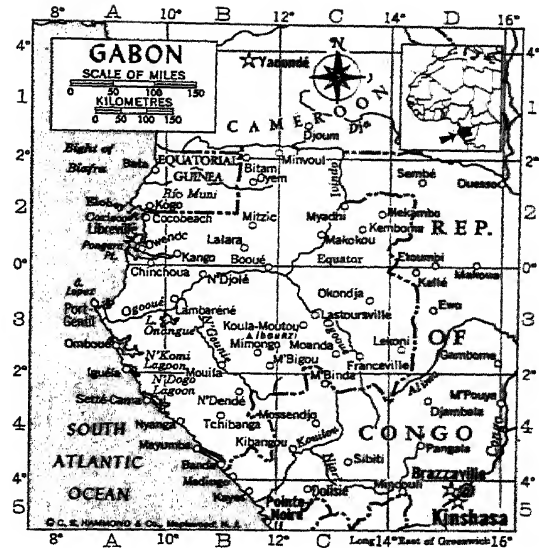
THE PEOPLE

The ethnic makeup of the Gabonese is diversified. Almost all the inhabitants are Bantu. Of the forty tribal groups, the largest tribes are the Fang (163,000), the Eshira (98,000), and the Adouma (65,000). Europeans, mostly French, number about 12,000. It is believed that the Pygmies were the original inhabitants of the country; only about 3000 remain. About 60 percent of the population is Christian; most of the remainder are animists. About 3500 Muslims live in Gabon. The official language is French; and the culture shows many French traits.

Population. Estimates of the population of Gabon in the late 1970's varied widely. The United Nations estimated the number of inhabitants at 530,000 in 1977, but other external analysts calculated the population at more than 1,150,000 in the same year. The official census of 1960-61 gave the population as 448,564; a census in 1970, which was rejected by the government, reported 950,009 inhabitants. Much of the country's interior is uninhabited.

Political Divisions and Principal Cities. Gabon is divided into nine prefectures, generally referred to as regions; these are subdivided into twenty-eight subprefectures and three posts of administrative control. Libreville and Port-Gentil are self-incorporated municipalities.

Libreville, the capital and largest city, has 169,200 inhabitants (1975 est.). Port-Gentil (77,611) is the center of the plywood and petroleum industries. Lambaréné (22,682) is the cen-



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ter for the oil-palm plantations in the region and site of the hospital established by the French medical missionary Albert Schweitzer (q.v.).

Education. Schooling is compulsory for all children between the ages of six and sixteen. In the mid-1970's about 140,000 students were attending primary and secondary schools. There are 77 secondary schools, technical institutions, and teacher-training colleges. The National University of Gabon was founded in 1970. About 1100 Gabonese are studying in foreign universities, mainly in France. Gabon has a School of Administration, an Institute for Legal Studies, a Polytechnic Institute, and an Institute for Research in Tropical Agriculture.

THE ECONOMY

The economy of Gabon is largely dependent upon the exploitation of its forest and mineral resources. Recent annual budget figures show revenues and expenditures of about \$77,250,000.



Above: Aerial view of Lambaréné, lumbering center and site of a hospital established by the French Nobel laureate and medical missionary Albert Schweitzer. Left: The mineral resources of Gabon are among the richest in the world. In this mill, earth containing manganese deposits is transported on modern conveyor belts.

United Nations



A group of Gabonese on their way home from market.

United Nations

Agriculture. The economy has a large subsistence agriculture sector, occupying two thirds of the active labor force. Cassava, banana, plantain, sugarcane, taro, and rice are grown for home consumption, and small amounts of cocoa, coffee, palm oil, peanuts, and pepper for export.

Forestry. Timber accounts for a little less than one half the exports by value. The principal wood is okoumé, a softwood that is used to make plywood. In the mid-1970's the annual cut of roundwood in Gabon was approximately 58,000,000 cu.ft. The timber industry has been strengthened by the construction of a cellulose factory. It is expected to create a new product, cellulose, for export, thereby expanding the market for the forest products of the country. The government is engaged in preservation and reforestation programs.

Mining. Mining has developed rapidly since independence. Annual production of very high-grade manganese ore reached about 2,100,000 metric tons in the mid-1970's. The rich deposits of iron ore located at Mekambo have reserves estimated at more than 500,000,000 tons. Exploitation of the iron ore has been hampered by the lack of transportation facilities, particularly railroads. A 350-mi. railroad is being constructed from Mekambo to the port of Owendo, which is being enlarged and modernized to handle the ore shipments. Uranium production annually totaled about 1,700,000 metric tons in the mid-1970's. Annual petroleum production was 10,200,000 tons. In 1968 an oil refinery was completed at Port-Gentil, as a joint venture of the

Central African Customs and Economic Union and foreign petroleum companies. Production of petroleum products exceeded 580,000 metric tons by the mid-1970's. Some gold also is exported.

Currency, Banking, and Trade. The currency is the C.F.A. franc (230.6 C.F.A. francs equal U.S.\$1; 1978), issued by the Central Bank of the States of Equatorial Africa and of Cameroon, and convertible into French francs. France, the United States, and West Germany are the principal trading partners.

Transportation and Communications. Gabon has about 4400 mi. of roads, of which about 2600 mi. are all-weather roads. A 540-mi. highway crosses Gabon from N. to S., linking the country with Dolisie in the Republic of Congo and Douala in Cameroon. Government planning has stressed road construction. The only railroad links M'binda with the Pointe Noire-Brazzaville Line. Libreville and Port-Gentil, the principal ports, have airports. The Ogooué R. and its tributaries, the Ivindo and N'Gounie rivers, provide navigable waterways. The government operates television and radio stations.

GOVERNMENT

The constitution adopted Feb. 21, 1961, and revised in 1975, provides for a parliamentary democracy with a presidential form of government.

Central Government. The president, who is both chief of state and head of government, is

GABOR

elected by universal suffrage for a seven-year term. The president appoints government officials, including the prime minister, and is commander in chief of the armed forces. Legislative power rests in the unicameral National Assembly, consisting of seventy members, all of whom are elected for terms of seven years.

Political Parties, Local Government, and Judiciary. The Gabon Democratic Bloc was the governing party in the late 1960's and controlled all the seats in the National Assembly. The Gabonese Democratic Party became the sole political party in 1968. Each of the nine regions is governed by a prefect. The judiciary comprises the Supreme Court, the High Court of Justice, a court of appeal, and a criminal court, as well as several courts of first instance.

HISTORY

The first contact with Europeans was with the Portuguese at the end of the 15th century. In the ensuing centuries the Portuguese, followed by French, Dutch, and English, carried on a lucrative trade in slaves until the beginning of the 19th century. The first permanent European settlement was made by the French in 1839 on the northern coast. Libreville was founded in 1849 by slaves who had been freed from a slave runner. Over the next several years the French extended their rule inland. The colony of Gabon was organized in 1910 as part of French Equatorial Africa. In May, 1957, the first Gabonese cabinet was formed, with Léon M'Ba (1902-67) as prime minister. In the referendum of September, 1958, Gabon voted to become a semiautonomous republic in the French Community. Gabon declared its independence on Aug. 17, 1960, remaining in the community, however. In 1961, M'Ba was elected president. A military coup overthrew his government on Feb. 18, 1964. French troops sent in accordance with the Franco-Gabonese defense agreement intervened and reestablished the M'Ba government on Feb. 19. M'Ba was reelected president in March, 1967. Upon his death on Nov. 28, Vice-President Albert Bernard Bongo (1930-), whom M'Ba had named as his successor, became president. Bongo, who assumed the Islamic name Omar in 1973, was reelected in February, 1973. During the mid-1970's Gabon began to loosen its ties with France and the French-speaking regional organizations. With "Gabonization" the government has become a partner in many foreign firms, and Gabonese have filled management positions once held by foreigners.

GABOR, Dennis (1900-), British physicist and engineer, born in Budapest, Hungary, and educated at the Technical University, Budapest,

and the Technische Hochschule, Charlottenburg, Germany. He taught and performed research in Germany until 1933, when he emigrated to Great Britain. A naturalized British citizen, Gabor worked for various British companies until 1949, when he joined the faculty of the Imperial College of Science and Technology of the University of London. In 1967 he was named senior research fellow and professor emeritus of applied electron physics at the Imperial College. The same year, he became a staff scientist of the Columbia Broadcasting System Laboratories, Stamford, Conn., for which he had been a consultant since 1957.

Gabor concentrated his research work on electron and plasma physics, electron microscopy, and physical optics. He became prominent for his invention (1947) and the subsequent development of holography, a lensless system of three-dimensional photography. This technique utilizes a coherent light source such as that provided by a laser (q.v.) beam. For this work, Gabor was awarded the 1971 Nobel Prize in physics. His publications include *The Electron Microscope* (1946) and *Inventing the Future* (1963). See PHOTOGRAPHY: *Historical Development: 20th Century: Holography*.

GABORONE, city and capital of Botswana, near the Notwani R., 160 miles N.W. of Johannesburg, South Africa. Gaborone is a livestock trading center on the railroad from South Africa to Rhodesia. It is the headquarters of the Batlokwa tribe. The city was founded by the British South Africa Company in the 1890's, as part of the Gaborone Block, reserved for white settlement. In 1965 it succeeded Lobatsi, about 50 mi. to the s., as capital of what was then Bechuanaland Protectorate. Pop. (1972) 14,000.

GABRIEL, angel (q.v.) of high rank in Jewish, Christian, and Islamic tradition. He is one of the seven archangels (see ARCHANGEL) in Jewish angelology and is listed as one of the "four great archangels" in the Apocryphal book of Enoch (see book of ENOCH), the others being Michael (q.v.), Uriel, and Suriel (Raphael). Gabriel is the heavenly messenger who appears in order to reveal God's will. In the Old Testament, Gabriel interprets the prophet's vision of the ram and the he-goat (Dan. 8:15-26) and explains the prediction of the Seventy Weeks (or 490 years) for the duration of the exile from Jerusalem, previously announced to be seventy years by "Jeremiah the prophet" (Dan. 9:21-27). In the New Testament, he announces to Zacharias the birth of his son (Luke 1:11-20), who is destined to become known as John the Baptist (q.v.), and to Mary (q.v.) that she is to be the mother of Jesus



Taddeo Gaddi painted many altarpieces depicting the life of the Virgin Mary.
Metropolitan Museum of Art - Rogers Fund

Christ (q.v.; Luke 1:26). In post-Biblical literature Gabriel is frequently introduced. The Targum (q.v.) for 2 Chron. 32:21 says that he destroyed the host of Sennacherib (q.v.); the Talmud (q.v.) identifies as Gabriel the angel who showed Joseph (q.v.), son of the patriarch Jacob, the way to his brothers (Gen. 37:15–17) and also states that Gabriel was one of the angels who buried the body of Moses (q.v.), the Hebrew prophet and lawgiver (Deut. 34:6). Gabriel is the prince of fire and the spirit who presides over thunder and the ripening of fruits. He has the reputation of being an accomplished linguist, having taught Joseph the seventy languages spoken at Babel (see BABEL, TOWER OF). Among Muslims, Gabriel is believed to be the spirit who revealed the sacred writings to the Prophet Muhammad (q.v.). In art he is generally represented carrying either a lily, Mary's flower, at the Annunciation or the trumpet that he will blow on the Last Day. In Roman Catholicism he is a saint; his feast day is Sept. 29.

GAD (Heb., "fortune"), name of two characters in the Old Testament. 1. Son of the patriarch Jacob (q.v.) and of Zilpah, the handmaiden of Leah, Jacob's wife (Gen. 35:26). He was the eponymous ancestor of the tribe of Gad, which either conquered or was allotted a strip of land east of the Jordan R., about 25 mi. wide, extending from the southern shore of the Sea of Galilee (now Lake Tiberias) almost to the

northern shore of the Dead Sea (Num. 32). The tribe was warlike and is reported to have rendered great assistance to King David (q.v.) at one time. The Gadites were conquered in the 8th century B.C. by the Assyrian King Tiglath-pileser III (d. 727 B.C.), according to 1 Chron. 5:26, and are not again mentioned after their transportation as captives to Assyria. 2. A seer at the court of King David (q.v.). He wrote a book of the Acts of David (1 Chron. 29:29) and also helped arrange the musical services in the "house of God" (2 Chron. 29:25).

GADDI, Taddeo (about 1300–66), Florentine painter and architect, born in Florence, son of the artist Gaddo Gaddi (1260–1332). Taddeo Gaddi was the most important of the pupils of the Florentine painter Giotto (q.v.), assisting his master for twenty-four years, as well as painting independently. After Giotto's death Gaddi became the leading painter of the Florentine school (see FLORENTINE PAINTING AND SCULPTURE: *Florentine Painting*). His paintings are noted for their realism. His principal paintings consisted of frescoes and altarpieces. Among the former are the series illustrating the story of the Virgin, and the ceiling paintings "Eight Virtues" (both in the Baroncelli Chapel, Church of Santa Croce, Florence); "Last Supper" (refectory of Santa

Croce); and frescoes in the Church of San Francesco, Pisa. Among his altarpieces are two entitled "Madonna with Saints" (Church of Santa Felicità, Florence, and Church of San Giovanni Fuoricivitas, Pistoia), and "Madonna and Child with Saints" (Metropolitan Museum of Art, New York City); and a predella illustrating the life of Saint Lawrence (Brooklyn Museum). The series of paintings "History of Christ" and "History of Saint Francis" (formerly in the sacristy of Santa Croce, now in the Florence Academy and the Berlin Museum) are also attributed to Taddeo Gaddi. His architectural career, according to the Italian biographer Giorgio Vasari (q.v.), included the building of the Ponte Vecchio over the Arno R., Florence, and the continuation of Giotto's campanile, Florence. His son Agnolo Gaddi (d. 1396) studied under him and later worked in Rome and Prato in Toscana as well as Florence. His paintings are almost all of religious subjects, such as "Madonna and Child with Saints and Angels" (about 1390, National Gallery of Art, Washington, D.C.).

GADE, Niels Wilhelm (1817–90), Danish composer, born in Copenhagen. His *Ossian Overture* won an important prize in 1841. From 1844 to 1846 he was the assistant conductor of the Gewandhaus Orchestra in Leipzig, one of the most noted in Europe, and in 1847–48 succeeded the German composer and conductor Felix Mendelssohn (see under MENDELSSOHN) as the conductor of the orchestra. In 1848 he returned to Copenhagen where he was the conductor of the Musical Union and, after 1861, musical director at the court.

Gade was the principal Danish composer of the 19th century. He belonged to the Romantic school of music, being particularly influenced by the works of Mendelssohn and of the German composer Robert Schumann (q.v.); his compositions also exhibit the influence of Scandinavian folk songs. His compositions include eight symphonies, five overtures, two marches, chamber-music works, works for piano, fourteen cantatas, one opera, and many songs.

GADFLY, common name of any of various flies which are parasitic on animals or human beings, particularly the botfly and the horsefly (qq.v.). Figuratively, a person who goads others by persistent annoyance.

GADOLINIUM, metallic element with at.no. 64, at.wt. 157.25, b.p. about 3000° C. (5432° F.), m.p. about 1320° C. (2408° F.), sp.gr. 7.97, and symbol Gd. It was named after the Finnish chemist John Gadolin (1760–1852). It is one of the rare earths (q.v.) and occurs with other rare

earths in many minerals, such as samarskite, gadolinite, monazite, and some varieties of Norwegian ytter spar. It is the fortieth element in order of abundance in the crust of the earth. Gadolinium oxide was first separated from other rare earths by the Swiss chemist Jean de Marignac (1817–94) in 1880. The oxide and many salts of gadolinium have been prepared. Gadolinium oxide is white and the salts are colorless. Because gadolinium has the largest known cross-section, or stopping power, for neutrons of any element, it has an important potential application as a component of control rods in nuclear reactors. Like the other rare earths, it is used in electronic apparatus such as vacuum tubes, capacitors, masers, and ferrites; in metal alloys; in high-temperature furnaces; and in apparatus for magnetic cooling.

GADSDEN, city in Alabama, and county seat of Etowah Co., on the Coosa R., about 60 miles N.E. of Birmingham. The city has railroad service and a municipal airport. The chief products of the surrounding region are coal, iron ore, limestone, clay, cotton, and dairy products. Hydroelectric power is supplied by the Coosa R. Gadsden is a major industrial center, and is one of the largest cities in the State. The principal industries in the city manufacture iron and steel products, automobile tires and other rubber goods, and concrete pipe. The city was founded in the 1840's and incorporated in 1871. Pop. (1960) 58,088; (1970) 53,928.

GADSDEN, name of a family of American public figures.

Christopher Gadsden (1724–1805), Revolutionary leader, born in Charleston, S.C., and educated in England. In 1765 he was the delegate of the colony of South Carolina to the assembly that met in New York City to protest the Stamp Act; see STAMP ACT CONGRESS. From 1774 to 1776 he was an active member of the first and second Continental Congresses, and in 1776, after the American Revolution began, Gadsden was commissioned a colonel of South Carolina, later being promoted to brigadier general. He resigned his commission in 1778, and was made a member of the State constitutional convention. In 1780, as lieutenant governor of the State, he signed the document surrendering Charleston to the British, who had besieged the city for six weeks. He was released on parole by the British commander Sir Henry Clinton (q.v.), but a few weeks later he was rearrested by order of General Charles Cornwallis (q.v.) and imprisoned for ten months in Saint Augustine (q.v.), then Fort Augustine in the British colony of Florida. In 1782, although Gadsden was elected gov-

ernor of South Carolina, he refused to accept the office because of illness suffered during his imprisonment. He was, however, a member of the South Carolina convention which ratified the United States Constitution in 1788, and in 1790 served in the convention which drafted a new State constitution.

James Gadsden (1788–1858), soldier, railroad promoter, and diplomat, grandson of Christopher, born in Charleston, S.C., and educated at Yale College (now Yale University). He joined the United States Army in 1806, and served with distinction in the War of 1812 (q.v.). Gadsden was appointed aide-de-camp to General Andrew Jackson (q.v.) in 1818, and served under the general during the campaign of 1818 and 1819 against the Seminole Indians. In 1821 he resigned from the army and settled in Florida. Two years later he was appointed United States commissioner to direct the removal of the Seminole Indians to southern Florida. He returned to Charleston in 1839 and in 1840 became president of the Louisville, Cincinnati, and Charleston Railroad, which was reorganized as the South Carolina Railroad in 1842. Gadsden envisaged a southern transcontinental railroad route to the Pacific Ocean, and played a leading role in promoting the combination of western and southern trunk lines to effect such a route. He was appointed U.S. minister to Mexico in 1853 and in that capacity negotiated a treaty providing for the purchase by the U.S. of a tract of land including the most practicable route for the projected southern railroad. Actual construction of the railroad, however, was blocked by Northern and antislavery interests, who feared the railroad would facilitate the extension of slavery into California. See GADSDEN PURCHASE, THE.

GADSDEN PURCHASE, THE, tract of land lying within the present States of New Mexico and Arizona, purchased by the United States from Mexico in 1853 and named for James Gadsden (see *under* GADSDEN). The region concerned, 45,535 sq.mi. in area, adjoins the Mexican border; it is bounded on the E. by the Rio Grande, on the N. by the Gila R., and on the W. by the Colorado R.

The 1853 purchase was necessitated by misunderstandings arising from the 1848 Treaty of Guadalupe Hidalgo, which ended the Mexican War (q.v.). That treaty had defined the border between Mexico and the U.S. only vaguely, and the U.S. wished to retain possession of the Mesilla valley (now in New Mexico), which was also claimed by Mexico. Moreover, one article of the treaty had made the U.S. responsible for the restraint of marauding Indians on the fron-

tier; the provisions of this article had not been enforced, and Mexico claimed millions of dollars in damages. By the terms of the Gadsden Treaty, which included a payment of \$10,000,000 to Mexico, the U.S. was permitted to abrogate the article pertaining to Indians, cancel the claims for damages, and acquire the land afterward known as the Gadsden Purchase. The treaty was ratified, with minor changes, by the United States Senate in 1854. In Mexico, however, the sale met with great opposition, and President Antonio López de Santa Anna (q.v.), who had played a major role in the negotiations, suffered a further decline in his already dwindling popularity.

GADWALL, large, mainly freshwater duck, *Anas strepera*, native to North America, Europe, North Africa, and parts of Asia. Males have brownish heads, grayish bodies, dark bills, and yellow feet. The females are browner. Both sexes of the gadwall have a white, black-and-brown speculum, or wing patch. Although normally a surface-feeding bird, and therefore almost entirely herbivorous, the gadwall often dives for its food underwater. In North America it nests mainly in western and central regions, and winters principally in the lower Mississippi valley and Mexico. The gadwall frequently associates with the American widgeon and pintail (qq.v.).

GAEA or GE, in Greek mythology, the personification of Mother Earth, and the daughter of Chaos (q.v.). She was the mother and wife of Father Heaven, who was personified as Uranus (q.v.). They were the parents of the earliest living creatures, the Titans (q.v.), the Cyclopes (see CYCLOPS), and the Hecatonchires, three hundred-handed, fifty-headed monsters. Fearing and hating the monsters, though they were his sons, Uranus imprisoned them in a secret place in the earth, leaving the Cyclopes and Titans at large. Gaea, enraged at this favoritism, persuaded her son, the Titan Cronus (q.v.), to overthrow his father. He emasculated Uranus, and from his blood Gaea brought forth another race of monsters, the Giants, and the three avenging goddesses, the Erinyes (q.v.). Her last and most terrifying offspring was Typhon, a hundred-headed monster, who, although conquered by the god Zeus (q.v.), was believed to spew forth the molten lava flows of Mt. Etna.

GAELIC LANGUAGE, any of the six languages comprising the Celtic branch of Indo-European languages; often restricted to the three languages of the Goidelic group of Celtic languages (Scottish Gaelic, or Erse, Irish Gaelic, and Manx); popularly applied only to Scottish

GAELIC LANGUAGE

Gaelic. In this article it refers to the Goidelic group.

Irish Gaelic. Irish Gaelic is the oldest of the Goidelic languages. Ancient written examples exist in the Ogham inscriptions, about 370 inscribed gravestones, scattered through south-western Ireland and Wales, dating from the 5th to the 8th centuries A.D. The inscriptions consist almost entirely of proper names carved in a special alphabet in which each sound is represented by a fixed number of lines below, above, or through a horizontal line. Irish Gaelic can be grouped into four periods: Old Irish (about 800–1000), typified by the *Book of Armagh* (10th century); Early Irish or Early Middle Irish (1200–1500), characterized by the tales of the *Book of the Dun Cow* (11th century); Middle Irish (1200–1500), characterized by the *Yellow Book of Lecan* (14th century); and Modern Irish (from 1500); see IRISH LITERATURE. Originally a highly inflected language, Irish underwent a deterioration of the flectional system in each period. In Modern Irish the flectional system has eroded to essentially two noun cases, nominative and genitive, with the dative surviving in the singular of feminine nouns, and to only two tenses in the indicative mood. It is spoken in the western, southwestern, and some northern parts of Ireland. In the past century, the number of Irish-speaking persons has declined from 50 percent of the population of Ireland to less than 20 percent.

Scottish Gaelic. At first identical in essential features with Irish Gaelic, Scottish Gaelic began to emerge as a distinct dialect in the 16th century, with many loan words, especially from English and Norse. The voiced b, d, and g of Irish become the voiceless stops p, t, and c in Scottish Gaelic; the Irish p, t, and c, aspirated as an initial letter or following a stressed vowel, became the preaspirated occlusives chp, cht, and chk.

Scottish Gaelic exists in two main dialects, Northern and Southern, roughly geographically determined by a line up the Firth of Lorne to the town of Ballachulish and then across to the Grampian Mts. which it follows. The Southern dialect is more akin to Irish than is the Northern, and is more inflected. The main difference is the change of the é sound, which is *eu* in Northern dialect and *ia* in Southern. Thus the word for grass in Northern is pronounced *feur* and in Southern, *fiar*.

Approximately 3 percent of Scotland is bilingual, but only about 0.0014 percent speaks Scottish Gaelic exclusively. About 30,000 Scottish Gaelic speakers are also found in Canada.

The alphabet of Irish and Scottish Gaelic is identical, consisting of eighteen letters. Vowels are broad and small; the language has over twenty diphthongs and seven triphthongs. The forming of large numbers of compound words is characteristic of the vocabulary structure.

Manx. The name Manx is used for a dialect of Irish once spoken on the Isle of Man. In 1952 only about twenty persons speaking Manx remained; thus Manx may be considered an extinct language.

GAELIC LITERATURE. See IRISH LITERATURE; SCOTTISH LANGUAGE AND LITERATURE.

GAFFNEY, city in South Carolina, and county seat of Cherokee Co., about 17 miles N.E. of Spartanburg, near the North Carolina State line. Gaffney is a marketing and shipping center for the area, in which limestone quarries are worked. Manufactures include foundry products, clothing, textiles, and mill equipment. It is the site of Limestone College, founded in 1845; Cowpens National Battlefield Site and Kings Mountain National Military Park are nearby. Pop. (1960) 10,435; (1970) 13,253.

GAGARIN, Yuri Alekseyevich (1934–68), Soviet astronaut, born near Smolensk. After graduating from technical and vocational schools, he enrolled at the Soviet Air Force cadet-training center at Orenburg, graduating as a pilot in 1957. On April 12, 1961, Gagarin, then a major in the air force, became the first man to travel in space when he rode aboard the rocket-propelled earth satellite Vostok (later referred to as Vostok I) on a 17,000-m.p.h. single orbit of the earth. The flight lasted 1 hr. 48 min., on an elliptical course having an apogee of 203 mi. and a perigee of 112 mi. He was killed in the crash of a test airplane. See ASTRONAUTICS: *Space-Age Programs: Manned Space Flights*.

GAGE, Thomas (1721–87), British general and colonial governor in America, born in Fille, Sussex, England. He entered the British army in 1740 with a lieutenancy and, after serving in Scotland and Flanders, was sent to America in 1754 as lieutenant colonel under General Edward Braddock (q.v.) in the French and Indian War (q.v.). In 1761 Gage was appointed a major general and military governor of Montréal, where his unyielding character and stern efficiency brought him to the attention of the colonial authorities. From 1763 until his return to England in 1772 he was commander of all British forces in North America; he was promoted to lieutenant general in 1770. In 1774 he returned to America to become governor and military commander of the Massachusetts colony. His rigorous enforcement of unpopular British measures,

such as the Boston Port Bill (q.v.), aggravated an already tense situation; on April 18, 1775, he sent an expedition to destroy military stores belonging to colonists at Lexington and Concord, resulting in the Battle of Lexington (April 19) and the beginning of the American Revolution (q.v.). On June 17, he ordered the attack on the American forces occupying Breed's Hill, and was widely criticized for the heavy British casualties that resulted; see BUNKER HILL, BATTLE OF. Appointed commander in chief in North America in August, 1775, he resigned two months later and returned to England. In 1782 he was appointed a full general.

GAG RULES, in American history, general designation of a number of procedural rules adopted by the House of Representatives from 1836 to 1844, designed to exclude from consideration by the House, or by House committees, petitions asking the abolition of slavery in the District of Columbia. The first such rule was introduced in 1836 by Congressman Henry Laurens Pinckney (1794–1863) of South Carolina. The rules were supported by Southern Congressmen, and also by many Northern Representatives who regarded the antislavery petitions as inflammatory and inimical to the continued union of the States.

John Quincy Adams (q.v.), former President of the United States and then a member of the House from Massachusetts, led the long fight to abolish the gag rules. He contended that, because the Federal Constitution forbade Congress to enact laws abridging the right of petition, the refusal of Congress to consider petitions was, in effect, an unconstitutional nullification of the right of petition. At the beginning of each session, when the House adopted its rules of procedure, Adams moved to strike out the offending gag rule. Finally, on Dec. 3, 1844, he was successful, and the gag rule was abolished.

GAILLARDIA, genus of American herbs in the Thistle family, Compositae, named for Gaillard de Marentonneau, a French amateur botanist. Gaillardias, commonly called blanket flowers, the herbs are annual, biennial, or perennial. Two wild species grow in western United States: *G. lutea*, with yellow flowers, and *G. aristata*, with bright yellow ray flowers, deep red at the base in some varieties, and brownish-purple disk flowers. Also a popular perennial garden flower, the latter blooms from early summer to late autumn, growing 2 to 3 ft. tall. *Gaillardia pulchella* is an annual species with purple disks and yellow ray flowers which have rose-purple shading at the base. Native to the central U.S., it

grows 12 to 20 in. tall and has two major varieties: var. *lorenziana*, with enlarged, tubular, ray flowers, and var. *picta*, with heads larger than those of the typical *G. pulchella* and rays in shades of yellow, red, or white. Popular as cut flowers, gaillardias grow best in open, well-drained spaces.

GAINESVILLE, city in Florida, and county seat of Alachua Co., equidistant from the Atlantic Ocean and the Gulf of Mexico, and 70 miles s.w. of Jacksonville. The city is served by railroads, and is the commercial center and shipping point of an agricultural, lumbering, and surface-mining area producing tobacco, pecans, garden truck, citrus and other fruits, livestock, tung trees, pine, and phosphate rock. Gainesville is noted for the manufacture of tung oil; see TUNG. Other industries in the city include meat packing, poultry processing, and the manufacture of wood products, electronic tubes, cement, and automobile batteries. Gainesville is the site of the University of Florida, founded in 1853, the Florida State Museum, and two tung-oil research plants of the United States Department of Agriculture. It was settled about 1830 as Hog Town, and in 1853 was renamed Gainesville in honor of General Edmund Pendleton Gaines (1777–1849), who held commands in the War of 1812 and the Seminole Wars (qq.v.). It was incorporated as a town in 1869 and as a city in 1907. Pop. (1960) 29,701; (1970) 64,510.

GAINSBOROUGH, Thomas (1727–88), British portrait and landscape painter, born in Sudbury, Suffolk, England. He showed artistic ability at an early age, and when he was fifteen he studied drawing and etching in London with the French engraver Hubert Gravelot (1699–1773). Later he studied painting with the painter of historical events Francis Hayman (1708–76). Through Gravelot, who had been a pupil of the great French painter Jean Antoine Watteau (q.v.), Gainsborough came under the influence of Watteau. Later he was also influenced by the painters of the Dutch school and by the Flemish painter Sir Anthony Van Dyck (q.v.). From 1745 to 1760 Gainsborough lived and worked in Ipswich. From 1760 to 1774 he lived in Bath, a fashionable health resort, where he painted numerous portraits and landscapes. In 1768 he was elected one of the original members of the Royal Academy; and in 1774 he painted, by royal invitation, portraits of King George III (q.v.) and Charlotte Sophia, Queen Consort of Great Britain (1744–1818). Gainsborough settled in London the same year, and until his death was the favorite painter of the British aristocracy, becoming wealthy through commissions for portraits.

GAINSBOROUGH



"Master John Heathcote", one of about two hundred portraits by Thomas Gainsborough.

National Gallery of Art

Gainsborough is considered one of the greatest English portrait painters, and also one of the outstanding English landscape painters. In all he executed over five hundred paintings, of which more than two hundred are portraits. His portraits are characterized by the noble and refined grace of the figures, by poetic charm, and by cool and fresh colors, chiefly greens and blues, thinly applied. Among his important portraits, many of them world-famous, are "Orpin, the Parish Clerk" (Tate Gallery, London); "The Bailie Family" (1784) and "Mrs. Siddons" (1785), both in the National Gallery, London; "Perdita Robinson" (1781, Wallace Collection, London); "The Hon. Francis Duncombe" (about 1777, Frick Collection, New York City); "Mrs. Tenant" (1786-87, Metropolitan Museum of Art, New York City); and many in private collections, including "The Blue Boy" (about 1779, Huntington Collection, California).

The effect of poetic melancholy induced by

faint lighting characterizes Gainsborough's paintings. He was obviously influenced by Dutch 17th-century landscape painting; see DUTCH PAINTING. Forest scenes, or rough and broken country, are the usual subjects of the landscapes painted by Gainsborough. Among his most notable landscapes are "Cornard Wood" (1748), and "The Watering Place" (1775), both in the National Gallery, London. Gainsborough also executed many memorable drawings and etchings.

GAINSVILLE, city in Texas, and county seat of Cooke Co., about 59 miles N.W. of Dallas. The city is a processing, marketing, and shipping center for the region which produces farm- and dairy-products, timber, and oil. The city has varied manufacturing, and an oil refinery. It is the site of Cooke County Junior College, founded in 1924. Pop. (1960) 13,083; (1970) 13,830.

GAIRDNER, James (1828-1912), British historian, born in Edinburgh, Scotland, where he was

educated. He was appointed clerk in the Public Record Office in London in 1846 and by 1859 had attained the position of assistant keeper of public records, a post which he filled for thirty-four years. Among the writings he edited are *Memorials of Henry VII* (1858), *Calendar of the Letters and Papers of the Reign of Henry VIII* (21 vol., 1862–1910), and the *Paston Letters* (3 vol., 1872–75). Gairdner was also the author of *The Life and Reign of Richard III* (1878), *The English Church in the 16th Century* (1902), and *Lollardy and the Reformation in England* (4 vol., 1908–13).

GAISERIC. See GENSERIC.

GAIUS CAESAR. See CALIGULA.

GALACTIC EQUATOR or **GALACTIC CIRCLE.** See MILKY WAY.

GALAGO, genus of African lemurs, sometimes called bush babies. They are nocturnal and arboreal in habit, living on fruit and insects. The smaller species build nests in trees. The largest species, *G. crassicaudatus*, found on the east coast of Africa, measures about 2 ft. 4 in. from the tip of the nose to the end of the bushy tail. The smallest species, Demidoff's galago, measures only about 5 in., exclusive of the tail. The tails of galagos are longer than their bodies; their hind legs are longer and stronger than their forelegs, with two of the ankle bones (*calcaneum* and *navicular*) very much elongated. Their strong digits, well adapted for grasping branches, are all nail-bearing except the second on the hind foot, which is clawed. Galagos are covered with a soft, fawn-gray or brown, woolly fur. They are distinguished from other lemurs by their dentition and by their habit of folding their large, hairless, thin ears lengthwise close to the head when at rest. The head is small and round like that of a cat. The eyes are of immense size as compared to the head, of a rich brown color, translucent, marked with minute lines, and with large, oval pupils contracting in daylight to vertical slits. Galagos usually have one or two young per litter. They have been trained to catch mice and insects. See also LEMUR.

GALAHAD, Sir, in late romances of the Arthurian Cycle (q.v.), son of Lancelot du Lac (q.v.) and Elaine, daughter of King Pellès. Galahad, because of his purity of heart and consecration of purpose, was the only knight of the court of King Arthur able to sit in the Siege Perilous, the seat of danger in which only those destined to realize the mystical quest of the Holy Grail could sit without being struck dead; and with Percivale and Sir Bors, only one of three to pursue the quest of the Grail. See GRAIL, THE HOLY.

GALANTHUS, genus of hardy, perennial, bulbous herbs of the Amaryllis family, Amaryllidaceae, comprising the snowdrops, and found in Europe and western Asia. The genus is characterized by solid scapes and nodding flowers; three inner perianth segments with two-lobed lips are complemented by three larger, outer segments. Snowdrops are grown for their single, fragrant, green-and-white flower which blooms in early spring, often while snow is still on the ground. The common snowdrop, *G. nivalis*, having grasslike leaves up to 9 in. long and a height of up to 12 in., is extensively known as a garden flower; its drooping flower is fragrant. A larger species of galanthus, the giant snowdrop, *G. elwesii*, is found in the eastern Mediterranean.

GALÁPAGOS ISLANDS or **COLÓN ARCHIPELAGO**, group of islands in the Pacific Ocean, constituting a province of Ecuador. The archipelago consists of fifteen large and several hundred small islands lying on or near the equator about 650 miles w. of Ecuador. The principal islands are Isabela (Albemarle), San Cristóbal (Chatham), San Salvador (James), Santa María (Floreana), and Santa Cruz (Indefatigable). The total land area of the island group is about 3000 sq.mi.

Isabela, the largest island (area 1650 sq.mi.), differs from the others in the irregularity of its shape. In general, the islands are roughly circular, with level shorelines and mountainous interiors culminating in high central craters, some of which rise more than 5000 ft. above sea level. Eruptions have occurred in recent years on Isabela. The islands are fringed with mangroves; farther inland, although still in coastal regions, where little rain falls, the vegetation consists chiefly of thorn trees, cactus, and mesquite. In the uplands, which are exposed to a heavy mist, the flora is more luxuriant. The climate and the temperature of the waters surrounding the islands are modified by the cold Humboldt Current from the Antarctic.

The Galápagos group is noted for its fauna, which includes numerous animals found only on specific islands and others peculiar to the archipelago. Six species of giant tortoise (old Sp. *galápagos*) are found in the archipelago and give it its name; such tortoises are found nowhere else in the world. The largest of these tortoises, *Testudo vicina*, found on Isabela Island weighs almost 500 lb. and its shell reaches a length of more than 4 ft. Although part of the Galápagos is a wildlife sanctuary, the giant tortoises are in danger of extinction because of the destruction of eggs and young by wild dogs, rats, and pigs, and of the adults by men who value their oil.

GALATEA

Giant tortoises that escape slaughter live more than a century. Other reptiles on the islands include two species of large lizards in the Iguana (q.v.) family: *Conolophis subcristatus*, a burrowing land lizard, and *Amblyrhynchus cristatus*, an unusual marine lizard which dives into the ocean for seaweed. The Galápagos contain as many as eighty-five different birds, some confined to specific islands and others with several subspecies on the same island. These birds include flamingos, cormorants, finches, and penguins. Sea lions are numerous, as are many different shore fish. In 1835, the British naturalist Charles Robert Darwin (q.v.), traveling on H.M.S. *Beagle*, spent six weeks studying the fauna of the Galápagos, particularly the variations in finches of the genus *Geospiza*. These observations furnished considerable data for his *Origin of Species*.

History. The islands were uninhabited at the time of their discovery by the Spanish in 1535. During the 17th and 18th centuries they were used as a rendezvous by pirates and buccaneers. British and United States warships and whaling vessels landed frequently at the Galápagos in the 19th century. The American novelist Herman Melville (q.v.) visited the islands on the whaler *Acushnet* in 1841 and wrote about them as *The Encantadas* or *Enchanted Islands* in *The Piazza Tales* (1856). Recent settlers from Ecuador, mainly on San Cristóbal and Isabela, are engaged in farming and in fishing for tuna and groupers. The administrative center is El Puerto Baquerizo Moreno, on San Cristóbal. American bases established during World War II were evacuated in 1946. Pop. (1971 est.) 3800.

GALATEA, in Greek mythology, one of the fifty Nereids, the daughters of Nereus (q.v.), the old man of the sea. The gay, mocking sea nymph was loved by the Cyclops Polyphemus (q.v.), an ugly giant with one huge eye in the middle of his forehead. Galatea did not return his love, however; she teased and ridiculed him, arousing his hopes with kind words and then rejecting him. In later legends, although her attitude toward the lovelorn Cyclops grew kinder, Polyphemus never won her. Galatea finally fell in love with Acis, a handsome young prince, whom Polyphemus killed in a jealous rage.

In Roman mythology, Galatea was the name of a statue of a beautiful woman that was brought to life by Venus (q.v.), goddess of love, in response to the prayers of the sculptor Pygmalion, who had fallen in love with his creation. See PYGMALION.

GALAȚI or **GALATZ**, city in Rumania, and capital of Galați Region, on the N. bank of the Dan-

ube R., about 110 miles N.E. of Bucharest. The city is built on a slight rise in the marshlands which are formed by the Siret R., 3 miles S.W. of the city, and the Prut R., 10 mi. to the E.; both rivers are part of the huge Danube estuary. Industrial establishments include large warehouses, grain elevators, sawmills, flour mills, rope factories, petroleum refineries, steel mills, and a shipyard. The city is also a principal port of entry for textiles and metal goods. The principal exports are cereal grains, cattle, and timber. Educational facilities include the Galați Polytechnic Institute, founded in 1948, and a Pedagogic Institute, founded in 1959. Pop. (1971) 183,954.

GALATIA, name of an ancient region of Asia Minor, named for the Galatians, a Gallic people from Europe who settled there in the early 3rd century B.C. The region that formerly comprised Galatia lies in the basins of the Kizilirmak and Deliceirmak rivers, on the great central plateau of Turkey. Galatia possesses some expanses of fertile soil, but most of the land is suitable only for pasturing the large flocks of sheep and goats raised there. In addition to the Gauls, many Greeks settled in the region; the inhabitants, therefore, were often referred to as Gallo-Graeci. Dominated by Rome through regional rulers from 189 B.C., Galatia and adjacent regions became a Roman province in 25 B.C. It was conquered by the Seljuks (q.v.) in the 11th century A.D. The Apostle Saint Paul (q.v.) visited Galatia, and addressed his Epistle to the Galatians to several churches there; see GALATIANS, EPISTLE TO THE.

GALATIANS, book of the New Testament (see BIBLE), in the King James Version, THE EPISTLE OF PAUL THE APOSTLE TO THE GALATIANS. It was written by Saint Paul (q.v.) to churches he had founded in the Roman province of Galatia (q.v.). The exact location of the churches addressed by Paul is unknown, despite intense scholarly research on the subject. Scholars generally date the Epistle from the middle of the 1st century A.D.

The occasion for writing the Epistle was the growing influence upon the Galatians of Jewish Christians who preached close observation of the Mosaic Law and Jewish rituals; see DECALOGUE; JUDAISM; TORAH. In so doing, these Jewish Christians deemphasized faith in Christ as a fundamental principal of Christianity, thereby challenging Paul's apostleship and authority (see APOSTLE).

To counteract this dangerous teaching, which might have turned Christianity into a sect within Judaism if unchecked, Paul asserts as the central

theme of the Epistle that faith in Christ, not "works of the law" (2:16), is the essential condition for salvation (chapters 3–5). To prove his claim to apostleship and the truth of his gospel (q.v.), Paul contends that he received both "by the revelation of Jesus Christ" (1:12), and that his authority has been accepted by the Judean Christians (chapters 1–2). An epilogue (6:11–18) reiterates the principal contents of the Epistle. This section apparently was written in Paul's own handwriting (6:11), in contrast to the body of the Epistle which probably was dictated to a scribe.

Primarily because of Paul's exposition of the doctrine of faith (q.v.), the Epistle to the Galatians has been a continuing source of inspiration and authority for Christian theologians. It is also historically valuable because of the autobiographical information it contains in the first and second chapters.

GALAUP, Jean François de. See LA PÉROUSE, JEAN FRANÇOIS DE GALAUP, COMTE DE.

GALAXY, name commonly applied to any of the vast aggregations of stars, gas, and dust present in space. Originally, the term "galaxy" was an alternative designation for the whole universe. See STARS

The Milky Way (q.v.), the vast stellar system that includes our sun, was once thought to be the extent of the universe, but in the early 1920's the American astronomer Edwin Powell Hubble (q.v.) established the fact that the numerous spirals and other luminous objects formerly considered to be nebulae (see NEBULA) were in reality great star systems outside the Milky Way. By extension, the term "galaxy" was used thereafter to denote any of the exterior systems. The latter are also known as extragalactic nebulae.

The Milky Way is now also referred to as the Galaxy or our Galaxy. The overall system of galaxies, constituting the observed universe, is called the metagalaxy. The entire universe consists of one or more metagalaxies. Galaxies that emit strong radiation in the radio portion of the spectrum (q.v.) are known as radiogalaxies. See also QUASARS; RADIO ASTRONOMY.

The exterior systems are scattered through space as far as the most powerful telescopes can explore. Within the range of the 200-in. Hale telescope at the Mount Palomar Observatory (q.v.), California, there are more than 800,000,000 galaxies. The stellar systems apparently occur in clusters. The Milky Way is a member of the local group that also includes the Magellanic Clouds (q.v.), the Great Spiral in Andromeda, and several others. The scale of extragalac-

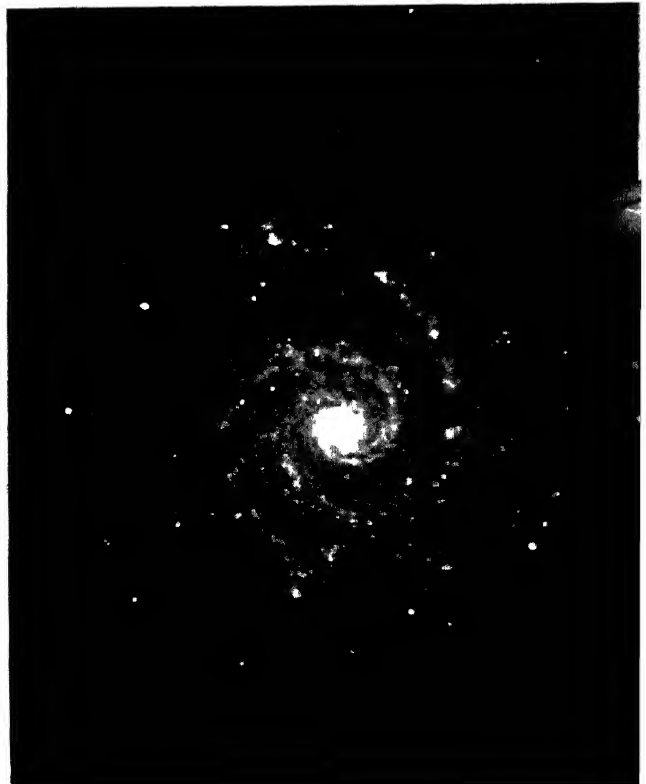
tic distances is based largely on studies of the Cepheid variables, stars that vary regularly in luminosity. After 1948, when the Hale telescope was placed in operation, the distances formerly determined for extragalactic nebulae had to be revised upward, as the Cepheid variables were found to be brighter than had been supposed earlier. For example, the Magellanic Clouds were computed in 1953 to be 175,000 light-years distant, more than twice the previously accepted figure. By 1956 astronomical reports indicated that the range of the 200-in. telescope was more than 3 billion light-years, three times its calculated range when it was placed in operation. Further adjustment of the distance scale may be required when photographic-magnitude standards are replaced by the more reliable photoelectric standards for star magnitudes; see MAGNITUDE.

The number of stars within an average galaxy appears to be about 10,000,000,000, but numerous dwarf galaxies contain about 10,000,000 stars or less, and a few systems, including the Milky Way, comprise several hundred billion.

Types of Galaxies. Galaxies are classified according to their shapes. There are two major divisions: regular systems, which are symmetrical around a central nucleus, and irregular systems, which have no apparent symmetry. Most galaxies are regular systems. Many of the regular sys-

The spiral galaxy in the constellation Pisces.

Mount Wilson Observatory





The Great Spiral in the constellation Andromeda, shown with its two satellite elliptical galaxies. American Museum of Natural History

tems are spiral in shape, their chief characteristic being a lens-shaped nucleus thickly populated with stars and encircled by flat, double-armed structures containing considerable gas and dust. Our own system is spiral, and the nearest and brightest of the exterior spiral systems is the Great Spiral in Andromeda. Other regular systems are elliptical or spheroidal in shape; the two satellite galaxies of the Andromeda spiral are examples of this type. The irregular systems lack rotational symmetry. Examples of the irregular type are the two Magellanic Clouds, the galaxies nearest our own, and regarded as satellites of the Milky Way.

Recent studies of the structure of galaxies indicate a relationship between their form and

their stellar populations. In spiral galaxies there are two distinct types of star population: type I, containing brilliant blue stars thousands of times more luminous than the sun, and type II, containing giant red stars believed to be very old. The type I population is found, together with clouds of gas and dust, only in the spiral arms. The type II population is concentrated in the central core of the galaxy. Elliptical galaxies are composed entirely of type II population; the blue stars, gas, and dust that characterize the arms of spiral galaxies are lacking. According to current theory, the stars evolved in most galaxies about 5,000,000,000 years ago. In the elliptical galaxies the stars supposedly were formed from all the gas and dust available to them at

that time, and as a consequence these systems now contain little nonstellar matter. Spiral galaxies contain, however, large quantities of gas and dust. Hence it is postulated that only a part of the original material in these systems was converted initially into stars. The remaining portion presumably formed the spiral arms in which new stars are still being born.

New Galaxies. Early in 1971, astronomers at the University of California at Berkeley and the California Institute of Technology tentatively identified two new galaxies in the proximity of the Milky Way. They named the galaxies Maffei 1 and Maffei 2 after the Italian astronomer Paolo Maffei, who had two years earlier noticed the unusual objects on infrared photographs; see INFRARED RADIATION.

See also COSMOGONY; EXPANDING UNIVERSE; RADAR ASTRONOMY.

GALBRAITH, John Kenneth (1908–), American economist, born on a farm in Ontario Province, Canada. He was educated at the universities of Toronto and California and taught economics from 1934 to 1942, first at Harvard University and later at Princeton University. He served with the National Defense Advisory Committee, the Office of Price Administration, and with several other Federal agencies of the United States. From 1943 to 1948 Galbraith was a member of the editorial board of *Fortune* magazine. In 1949 he returned to Harvard University as a professor of economics. From 1961 to 1963 Galbraith, on leave from Harvard University, served as U.S. ambassador to India. A prolific and lucid writer on economics, Galbraith is the author of *American Capitalism* (1951), a discussion of the balance of economic power among major American companies, and *The Affluent Society* (1958), in which he held that the U.S. had reached a stage in its economic development that should enable it to direct its resources more toward providing better public services and less to the production of consumer goods. His other books include *The Great Crash: 1929* (1955), *The New Industrial State* (1967), *Ambassador's Journal: A Personal Account of the Kennedy Years* (1969), and *A China Passage and Economics and the Public Purpose* (both 1973).

GALDÓS, Benito Pérez. See PÉREZ GALDÓS, BENITO.

GALE. See HURRICANE; WIND.

GALE, Zona (1874–1938), American journalist and author, born in Portage, Wis., and educated at the University of Wisconsin. She worked for some years on several Milwaukee newspapers, and from 1901 to 1904 wrote for the New York

World as well as for other newspapers and magazines. She first won recognition with a collection of short stories, *Friendship Village* (1908), depicting, in a somewhat idealized manner, life in a small Midwestern town. In much of her later work she was sharply critical of the harsh, repressive influences of that environment; a good illustration is her novel *Miss Lulu Bett* (1920), which she dramatized and for which she won the Pulitzer Prize for drama in 1921. Among her other writings are the novel *Birth* (1918); a volume of poetry, *The Secret Way* (1921); an autobiography comprising the two volumes *When I Was a Little Girl* (1913) and *Portage, Wisconsin* (1928); and the novels *Faint Perfume* (1923), *Borgia* (1929), and *Papa La Fleur* (1933).

GALEN (about 130–200 A.D.), Greek philosopher and physician, born in Pergamum (now Bergama, Turkey). He received his formal medical education in Smyrna (now Izmir, Turkey) and then traveled widely, gaining further medical lore. About 164 he settled in Rome and practiced medicine there; his patients included emperors and other notables, but he declined a post of official physician to the emperor. Little is known of the rest of his life, except that he seems to have spent much time in Rome, and died in Sicily.

Next to the Greek physician Hippocrates (q.v.), Galen was the outstanding physician of antiquity. For many centuries he was accepted as an authority by Greek, Roman, and Arabic physicians. In medieval times his reputation as a medical authority reached its zenith, and his writings became a theme for scholastic disputation. He is sometimes regarded as the father of experimental physiology, and made such experiments as cutting the spinal cords of animals at different levels, observing the effects in other parts of the organism. Galen was a strong opponent of the empiric school of medical thought; see MEDICINE: Greek. In philosophy he tended more toward Aristotelianism than to other schools; see ARISTOTLE: *Philosophy*. Galen discussed religion in his philosophical writings and expressed the monotheistic point of view. He produced about 500 tracts on medicine, philosophy, and ethics, many of which have survived in the original Greek or in Arabic translations. **GALENA**, or LEAD GLANCE, a mineral consisting of lead sulfide. It crystallizes in the isometric system, in well-formed cubes and cuboctahedrons, but it also occurs in large masses with a coarse or granular structure. Galena is characterized by perfect cubic cleavage, softness, heaviness, and the ease with which it is fused. Opaque, gray to black in color, galena has a me-

GALENA

tallic luster. Its specific gravity is 7.4 to 7.6 and its hardness 2.5 to 2.75.

Galena is the principal source of lead all over the world. It usually contains small amounts of silver and is often mined for the silver as well as for the lead. Smaller amounts of other metals, such as copper, gold, arsenic, antimony, and selenium, also occur in galena deposits. It is widely distributed and is frequently found in association with the sulfides of iron, copper, or zinc. In the United States the principal working deposits of galena are in Idaho, Kansas, Missouri, Montana, Oklahoma, Utah, and Wisconsin.

The name galena is from the Latin, *galena*, a name given to lead ore or the dross from melted lead. See LEAD.

GALENA, city in Illinois, seat of Jo Daviess Co., in the N.W. corner of Illinois on the Galena R., near the Iowa border. Galena is currently a market town and tourist center.

The French explorers who reached the area in the late 17th century found Indians working crude mines for the lead from which the city derives its name; see GALENA. Demand for lead brought thousands of would-be miners to the region, which was later known as the Galena-Dubuque Mining District. The town of Galena was laid out in 1826 along the Galena R., which flows into the Mississippi, and more than \$14,000,000 worth of lead was shipped from the town before 1860. The advent of the railroad and decreased demand for lead brought economic decline. The Galena Historical Society was founded in 1937 to restore and preserve documents, objects, and buildings important in the history of the Upper Mississippi lead-mine region. The house that the city gave to General Ulysses S. Grant (q.v.), the eighteenth President of the United States, is now a State memorial. Among the town's carefully restored 19th-century houses are exceptional examples of the Steamboat Gothic and Greek Revival styles. Galena was incorporated in 1835. Pop. (1960) 4410; (1970) 3930.

GALESBURG, city in Illinois, and county seat of Knox Co., 163 miles S.W. of Chicago. It has a municipal airport, and is a railroad divisional headquarters. Galesburg is the commercial and manufacturing center of an area producing coal, clay, livestock, grain, soybeans, and dairy products. Industrial establishments in the city include large railroad repair shops and yards, stockyards, soybean-processing plants, and factories manufacturing household appliances, agricultural machinery, automotive accessories, building supplies, and other products. Gales-

burg is the site of Knox College and the birthplace of the American poet and biographer Carl Sandburg (q.v.).

History. Galesburg was founded in 1836, coincident with the establishment of Knox College (now a private, coeducational institution emphasizing liberal arts). The college and town were founded by colonists from New York led by a Presbyterian minister, George Washington Gale (1789–1861), with the purpose of creating a community devoted to the promotion of Christian education and the abolition of slavery. The colonists, as a society, bought land from the Federal government within the area set aside for sale to the veterans of the War of 1812 and then bought it anew as individuals from their organization at a higher rate per acre in order to finance the construction of the college. The community became a station on the Underground Railroad (q.v.), by which runaway slaves were helped to safety. Galesburg was incorporated as a city in 1857. Pop. (1970) 36,290.

GALICIA, name applied to the region along the N. slopes of the Carpathian Mts., formerly an Austrian crownland, and now a part of Poland and the Ukrainian S.S.R. Galicia was an important Slavic principality in the 11th and 12th centuries, and later belonged to Poland. In 1772, at the time of the first partition of Poland (see POLAND: *History*), Galicia became a part of the Austrian empire, constituting an Austrian crownland until 1918, when it was claimed by the new Polish republic. In May, 1919, West Galicia was assigned to Poland by the Treaty of Versailles (q.v.) following World War I, and East Galicia was later given the right of self-determination. In December, 1919, East Galicia was granted autonomy under a Polish protectorate that was to endure for twenty years. This decree was approved in March, 1923, by the Council of Ambassadors, an agency of the League of Nations (q.v.). Galicia comprised the Polish provinces of Craków, Lwów, Stanisławów, and Tarnopol. In the invasion of Poland by Germany and the Soviet Union in 1939, Stanisławów, Tarnopol, and part of Lwów, populated mainly by Ukrainians and White Russians, were included in the Soviet zone of occupation. In the Polish-Soviet agreement of Aug. 16, 1945, Galicia was assigned to the U.S.S.R. and incorporated into the Ukrainian S.S.R., with Tarnopol changed to Ternopol', Lwów to L'vov, and Stanisławów becoming the Stanislav Oblast, which was renamed the Ivano-Frankovsk Oblast in 1962.

GALICIA (anc. *Gallaecia* or *Callaecia*), former province in N.W. Spain, bounded on the W. and N. by the Atlantic Ocean and the Bay of Biscay,

Zakopane, in Poland, near the Czechoslovakian border, offers a breathtaking view of the High Tatra Mts., part of the Carpathian mountain system in Galicia. Polish Travel Office



on the e. by León and Asturias, and on the s. by Portugal. The region is noted for the production of flax. The most important commodity is cattle. Galicia was a kingdom from 411 to 585, and again in the 11th century after the death of Ferdinand I (q.v.), King of Castile and León. In 1833 the ancient province was divided into the present provinces of La Coruña, Lugo, Orense, and Pontevedra.

GALILEE (Heb. *galil*, "circle"), northernmost region of Israel (q.v.). In ancient times the boundaries of the region were vague, but by the beginning of the Christian era, Galilee was a Roman province comprising all of what was then N. Palestine w. of the Jordan R. and Lake Tiberias (q.v.). The region is generally mountainous and is divided geographically into Upper Galilee in the N. and Lower Galilee in the

s. Peaks in Upper Galilee attain heights of about 3000 ft. above sea level, with Mt. Meiron measuring 3963 ft.; the terrain in the south is more level. The entire region is well watered; the mountain slopes are covered with shrubs, and grain is cultivated on the large plains. Upper Galilee was long famous for the cultivation of olives and grapes. During ancient times the area contained numerous towns and villages and was heavily populated with Syrians, Phoenicians, Arabs, Greeks, and Jews.

In 70 A.D., Tiberias, one of the important cities of Galilee, became a center of rabbinical learning. In 1516, Galilee was included in the area that became the Turkish province of Syria. **SYRIA: History.** After World War I, the League of Nations assigned the mandate for Palestine to Great Britain. In 1947, when the General Assembly



Galileo demonstrating his first telescope.

American Museum of Natural History

bly of the United Nations partitioned Palestine into an Arab and a Jewish state, Galilee was included in the Jewish sector and subsequently became part of Israel. In 1952 the Beit Natufa dam, part of an irrigation system, was constructed there.

GALILEE, SEA OF. See TIBERIAS, LAKE.

GALILEI, Galileo (1564–1642), Italian astronomer and physicist, commonly known only by his first name, born in Pisa. He received his early education in Greek, Latin, and logic at the monastery of Vallombrosa, near Florence. In 1581, at the request of his father, he went to the Univer-

sity of Pisa to study medicine, but in 1585 turned instead to the study of mathematics and science. Lack of money forced him to withdraw from the university in the same year, and he returned to Florence.

Early Work. Before studying mathematics Galileo's observation of the swinging of a lamp led him to the discovery of the isochronism of a pendulum (q.v.), that is, the fundamental law that the time taken for the oscillation of a pendulum is the same regardless of the amplitude of the swing. In Florence he invented the hydrostatic balance for measuring the specific gravity of solids; see DENSITY; HYDROMETER. In 1588 he wrote a treatise on the center of gravity

in solids, and as a result was given the post of mathematical lecturer at the University of Pisa. During the next two years, from 1589 to 1591, he performed a series of experiments demonstrating that bodies of different weights fall with the same velocity; that these experiments were performed from the top of the Leaning Tower of Pisa, as legend has it, is doubtful; see GRAVITATION. He also showed, during this period, that the path of a projectile is a parabola (q.v.). Galileo's discoveries, which were in complete contradiction to the prevailing theories of his Aristotelian contemporaries, provoked colleagues, and he resigned his post; see ARISTOTLE: *Philosophy*. In 1592 he was appointed professor of mathematics at Padua.

Astronomy. In 1609 Galileo learned that a telescope (q.v.) had been invented, and he soon built and improved telescopes for astronomical use; see ASTRONOMY. Using his telescopes he observed the mountainous configuration of the moon, the phases of Venus, Jupiter's satellites, and the existence of sunspots. He also discovered that the moon shines with reflected sunlight, and that the Milky Way is made up of countless stars. His investigations were rewarded in 1610 with an appointment as professor at the University of Florence and as philosopher and mathematician extraordinary to Cosimo II de' Medici, Grand Duke of Tuscany (1590–1620).

Galileo had accepted the Copernican theory of the solar system (see COPERNICAN SYSTEM) for some time, but not until his astronomical discoveries gave concrete and visible confirmation of the theory did he take a decided position in its favor, in his *Letters on the Solar Spots* (1613). The Copernican view of the solar system, which contradicted the prevailing theory that the earth is fixed and is the center about which the universe revolves, aroused the opposition of theologians, and Galileo was admonished by Pope Paul V (see under PAUL) to relinquish the heretical proposition that the sun is the center of the universe. Galileo promised to obey the pope and continued his work in astronomy. In 1630, however, he wrote *Dialogue on the Two Chief Systems of the World*, in which the Copernican system was brilliantly expounded and defended. This work was condemned by the theologians and its sale was forbidden. Galileo was summoned before the Inquisition (q.v.) at Rome in 1633 and forced to recant his belief that the earth moves about the sun. The legend that Galileo whispered "but it does move", as he rose from his knees after the renunciation of his views, is probably apocryphal.

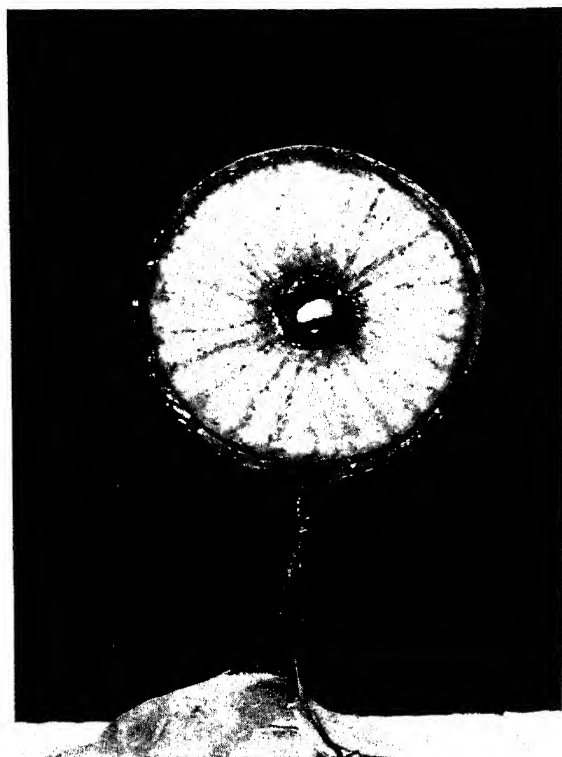
Mechanics. Galileo spent the remaining eight years of his life working in Florence. In 1636 he completed his *Dialogues on the New Science*, in which he recapitulated his early experiments and his later work in the theory of mechanics (q.v.). His last telescopic discovery, the librations of the moon (q.v.), was made in 1637; later in the same year he became totally blind.

Galileo applied mathematics, careful observation, experimentation, and inductive reasoning to the understanding of physical phenomena, and in this sense was the first modern physical scientist. In the field of astronomy his contributions were not of a theoretical nature, but consisted of his many telescopic discoveries. His most substantial contribution was his work in what later became the science of mechanics. Although he did not clearly formulate the relation of force and motion into definite laws, his work implied a knowledge and recognition of the laws of motion as later stated by the English scientist Sir Isaac Newton (q.v.); see also NEWTON'S LAWS OF MOTION.

Not all of Galileo's experiments were successful. He constructed a water thermometer that was extremely inaccurate. He correctly surmised that air had weight, but made a crude and inaccurate attempt to weigh it. He investigated the failure of suction pumps to lift water more than 34 ft. and drew the erroneous conclusion that a longer column of water broke of its own weight like an overloaded rope, and that "Nature abhors a vacuum". Even these experiments, however, were valuable, for they led the way for other scientists, such as his disciple Evangelista Torricelli (q.v.), to supply correct solutions for these problems.

GALION, city of Ohio, in Crawford Co., on the Olentangy R., about 11 miles S.E. of Bucyrus. Located in a diversified farming area, the city manufactures communication equipment, metal products, and road machinery. Founded in 1831, Galion was incorporated as a borough in 1840 and chartered as a city in 1878. Pop. (1960) 12,650; (1970) 13,123.

GALL, or CECIDIUM, swelling or excrescence of plant tissues caused by the action of parasites. Such swellings, which may occur on any part of a plant but are usually found in regions of active cell division and growth, are initiated by the chemical action of secretions of infesting organisms, usually insects or fungi. Galls assume a great variety of forms; each form is characteristic of the parasite that causes it, and usually each species of gall-forming parasite infests a specific organ of a specific plant. The growth of the gall may result either from a tremendous



Cross-section model of a spongy oak gall, which may form on leaves of red or scarlet oak.

American Museum of Natural History

swelling of the individual cells or from the rapid division of cells near the point of attack by the parasite. The gall provides a protective capsule for the parasite while it feeds on the inner tissues of the gall.

The most striking galls are caused by insects that begin their invasion by laying eggs in plant tissues. The resultant enlargement of surrounding tissue is caused either by growth-promoting stimulation furnished by the eggs or by secretions of the larvae. The gall wasps, a family of small hymenopterous insects, Cynipidae, include the greatest number of species of gall-forming insects. The members of these species restrict their attacks to about twenty genera of plants included in six families. The majority of insects affect the oaks, various species producing galls on roots, trunks, leaves, buds, flowers, or acorns. Several cynipids belonging to the genera *Amphibolips* and *Diplolepis* stimulate production of applelike galls known as oak apples. Specialization of function is so great in the cynipids that the mode of reproduction in some has been altered. *Plagiotrochus punctatus*, for example, produces in the summer a normal generation, the larvae of which cause blister galls on oak leaves. A second generation, entirely fe-

male, is produced in spring; its larvae cause irregular swellings on oak twigs. The unfertilized eggs of the second generation produce gall wasps of both sexes, which repeat the cycle.

Several galls caused by members of the genus *Cynips* are important sources of tannic acid. The commercial gallnut, *C. gallaetinctoriae*, which infests several Eurasian oaks, contains about 65 percent tannic acid. These gallnuts may be harvested and sold to leather-tanning or ink-manufacturing industries. See TANNINS.

GALL, Franz Joseph (1758-1828), German anatomist and physician, born in Tiefenbronn, and educated in medicine at the universities of Strasbourg and Vienna. He started his practice in Vienna in 1785. Gall believed that a relationship existed between the size and shape of the skull and the mental faculties and character, and that an examination of the skull would reveal information about brain function. This belief came to be called phrenology. Although the doctrine was anatomically unsound, it gained wide acceptance. Gall started to give a series of lectures on phrenology in Vienna in 1796, but in 1802 the government ordered them discontinued. Five years later Gall settled in Paris, where he practiced medicine and continued to work on phrenology despite an unfavorable report on his work by the Institute of France. He wrote *Anatomie et Physiologie du Système Nerveux en Général* ("Anatomy and Physiology of the Nervous System in General", 4 vol., 1810-19), the first two volumes with the German physician Johann Kaspar Spurzheim (1776-1832), and *Des Dispositions Innées de l'Âme et de l'Esprit* ("Of the Innate Inclinations of the Soul and the Spirit", 1811).

GALLA, African people of Hamitic origin, inhabiting the territory between central Ethiopia (q.v.) and the Sabaki R. in Kenya (q.v.). The name is thought to derive from the Arabic *ghalil*, "rough" or "wild", although in Shoa Province of Ethiopia it is connected with the Gala R. The Galla, who refer to themselves as Oromoto, are related to the Somali (q.v.) and to the Afars in the Danakil region of northeastern Ethiopia. They speak Galla, or Cushitic language, which is a branch of the Afro-Asiatic linguistic family; see AFRICAN LANGUAGES. The Galla are tall and longheaded, with brown complexions and regular features. A nomadic pastoral existence is followed by most of the Galla; some, however, live in agricultural settlements. Livestock raising and beekeeping are the primary occupations. Monogamy is generally the rule, but in some areas polygamy is practiced, the number of wives being dependent upon the economic status of

the husband. Some of the Galla are Muslims and others are Christians, adherents of the Coptic Church (see COPTS), but the majority follow an animistic paganism. Among the most important of the more than 200 Galla tribes are the warlike Tulama group, consisting of about thirty-five tribes, with traditions of caste and slaveholding, and the Wallo, consisting of about twenty-five tribes. The Galla are estimated to number about 7,000,000.

GALLATIN, Albert, in full ABRAHAM ALFONSE ALBERT GALLATIN (1761-1849), American statesman and financial expert, born in Geneva, Switzerland, and educated at the Academy of Geneva. He emigrated to the United States in 1780 and became successively a merchant, a French tutor at Harvard College, and a land speculator in western Pennsylvania and Virginia. He served in the Pennsylvania State legislature from 1790 to 1792. In 1793 he was elected to the United States Senate but in the following year was unseated because he was not a United States citizen of nine years' standing. He returned to his home in western Pennsylvania, and from 1795 to 1801 served in the United States House of Representatives. He was instrumental in establishing the Finance Committee (now the Ways and Means Committee) in the House and becoming the financial expert among the Republican minority. He was an advocate of free trade, and a severe critic of the Federalist Party (q.v.), opposing its financial policy and its advocacy of commercial treaties of reciprocal advantage with other nations.

In 1801 Gallatin was appointed secretary of the treasury by President Thomas Jefferson (q.v.), and served in that capacity until 1814. Between 1801 and 1807 he managed to reduce the public debt considerably and create a surplus of funds, despite the Louisiana Purchase (q.v.), which he had strongly supported. He opposed war as detrimental to national economy, and worked to bring a quick end to the War of 1812. At the close of the war, in 1814, he was prominent in the peace negotiations with Great Britain and in drawing up the Treaty of Ghent (see GHENT, TREATY OF). Gallatin served as minister to France from 1816 to 1823 and as minister to Great Britain in 1826-27. In 1827 he retired from politics and settled in New York City. From 1831 to 1839, Gallatin was president of a bank in New York City. He was interested in ethnology and was instrumental in founding, in 1842, in New York City the American Ethnological Society, of which he was elected the first president. From 1843 until his death he was president of the New York Historical Society.

GALLAUDET, name of an American family that included a father and two sons who devoted their lives to the education and welfare of the deaf.

Thomas Hopkins Gallaudet (1787-1851), pioneering educator of the deaf, was born in Philadelphia, Pa., Dec. 10, 1787, and educated at Yale College (graduated 1805) and Andover Theological Seminary (1814). Becoming interested in the teaching of the deaf, he went to Europe to learn the methods, including sign language, used there. After studying at the Institut Royal des Sourds-Muets in Paris, he returned in 1816 with a French teacher of the deaf, Lucien Clerc (1785-1869). Helped by a land grant from the United States Congress, the two founded the first free public school for the deaf in the U.S., the American Asylum for Deaf-Mutes (since renamed the American School for the Deaf), at Hartford, Conn. Some of the people Gallaudet trained went on to lead similar institutions and gave a strong impetus to the previously neglected education of the deaf.

Gallaudet retired as principal of the school in 1830 and devoted himself to various educational causes; he advocated establishing public schools for teacher training and providing higher education for women. He died in Hartford on Sept. 10, 1851.

Thomas Gallaudet (1832-1902), oldest son of Thomas Hopkins, born in Hartford. A graduate of Washington (now Trinity) College, he was a teacher at the New York Institution for the Deaf. Ordained an Episcopal priest in 1851, the following year he opened Saint Ann's Church for Deaf-Mutes in New York City. He also founded the Gallaudet Home for elderly deaf-mutes in Poughkeepsie, N.Y.

Edward Miner Gallaudet (1837-1917), youngest son of Thomas Hopkins, born in Hartford. A graduate of Trinity College, he was a teacher of the deaf and then head of the Columbia Institute for the deaf in Washington, D.C. In 1864 Congress made the school the first American institution of higher education for the deaf by accrediting it; in 1894 its senior division was renamed Gallaudet College. Gallaudet was among the earliest proponents of the teaching of lip-reading and speech to the deaf.

GALLBLADDER, muscular organ which serves as a reservoir for bile (q.v.), present in most vertebrates. In man, it is a pear-shaped membranous sac on the under surface of the right lobe of the liver just below the lower ribs. It is generally about 3 in. (75 mm) long and 1 to 1¼ in. (25 to 31 mm) in diameter at its thickest part; it has a capacity varying from 1 to 1½ fluid ounces. The

body (corpus) and neck (collum) of the gallbladder extend backward, upward, and to the left. The wide end (fundus) points downward and forward, sometimes extending slightly beyond the edge of the liver. Structurally, the gallbladder consists of an outer peritoneal coat (tunica serosa); a middle coat of fibrous tissue and unstriped muscle (tunica muscularis); and an inner mucous-membrane coat (tunica mucosa).

The function of the gallbladder is to store bile, secreted by the liver and transmitted from that organ via the cystic and hepatic ducts, until it is needed in the digestive process. The gallbladder, when functioning normally, empties through the biliary ducts into the duodenum to aid digestion by promoting peristalsis and absorption, preventing putrefaction, and emulsifying fats; see DIGESTION. For other body organs mentioned see separate articles. See also JAUNDICE.

Disorders of the Gallbladder. The major disorder associated with the gallbladder is the presence of gallstones, varying in shape and size from a pea to a small pear. Accreted from the constituent salts in the bile, they are most common in diabetic patients, Negroes, and women; their presence increases with age. Two of the reasons for the growth of gallstones are believed to be the presence of excessive amounts of substances such as calcium and cholesterol (q.v.) in the bile and the retention of bile in the gallbladder for a long period of time. Another common disorder of the gallbladder is cholecystitis, or inflammation of the organ, which is believed to be caused by the presence of highly concentrated bile. Chronic cholecystitis is sometimes aggravated by bacterial infection, leading to perforation and peritonitis (q.v.). A less common disease is the growth of malignant tumors, which are associated with gallstones and constitute about 3 percent of all cancer (q.v.) in man.

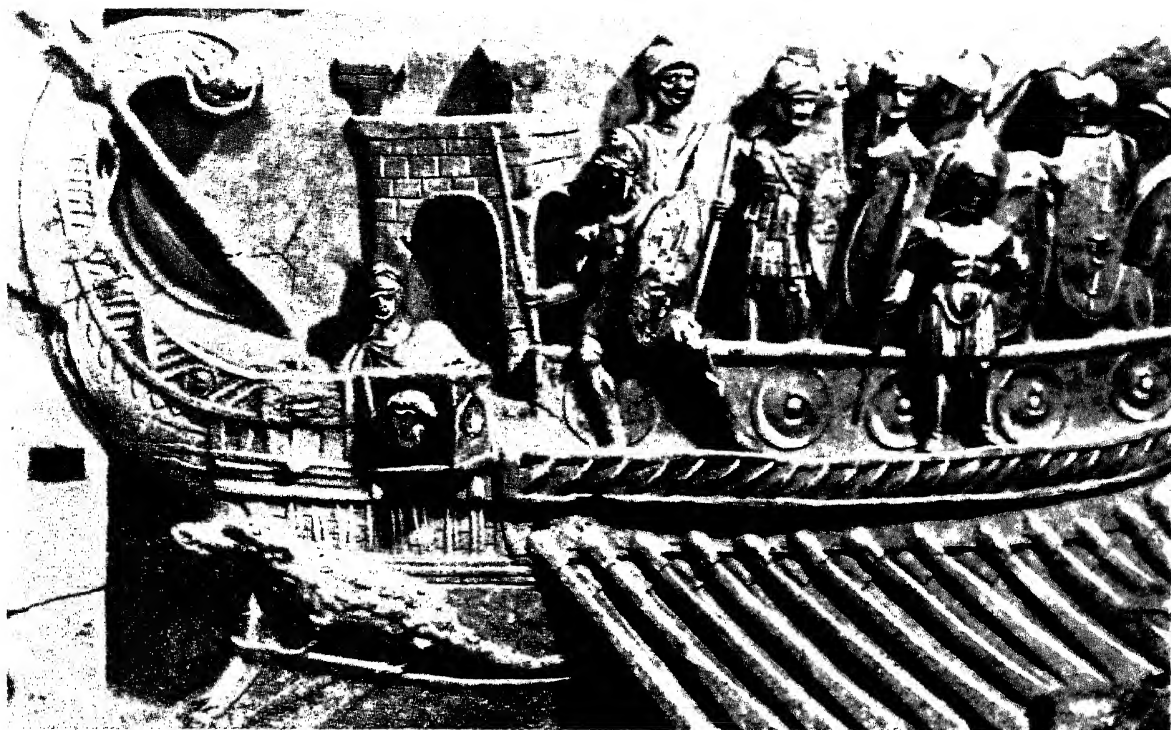
GALLE, formerly Point de Galle, city and seaport in Ceylon (now Sri Lanka), and capital of the Southern Province, on the s.w. coast of the island, about 70 miles s.e. of Colombo. Galle has an export trade in rubber, tea, rope, and coconut oil, fiber, and coir yarn. Galle was of little importance until the 16th century, when much of Ceylon was occupied by Portugal. During the Portuguese period and the later era of Dutch occupancy, it was a busy commercial port. Following the improvement of the port of Colombo (q.v.) by Great Britain during the 19th century, the prosperity of Galle declined. See CEYLON: *History*. Pop. (1970 est.) 71,700.

GALLEGOS, Rómulo (1884–1969), Venezuelan novelist and statesman, born in Caracas, and educated at the Colegio Sucre and the Universidad Central de Venezuela. He worked as a teacher from 1912 until 1922, when he was appointed director of the Liceo Andrés Bello. He remained in this post until 1930, and during this period published several novels dealing with Venezuelan life. His best-known work, *Doña Bárbara* (1929; Eng. trans. 1931), depicted the unsuccessful struggle against the forces of greed, corruption, and tyranny in Venezuela. Because the novel was deemed critical of dictator Juan Vicente Gómez (q.v.), Gallegos exiled himself in 1931, first to the United States and later to Spain until the death of Gómez in 1935. Upon his return to Venezuela he was appointed minister of education, but his efforts at school reform failed and he was forced to resign after one year. In 1945 he participated in the military coup that brought Rómulo Betancourt (1908–) to power as provisional president. Gallegos was himself elected president in a popular election but served only three months in 1948 before he was forced into exile after a military coup. He returned to Venezuela in 1958.

GALLEY, in maritime history, genre name applied to a variety of large, seagoing men-of-war propelled by oars and, more frequently, by sail. In the 18th and 19th centuries the name was applied also to certain classes of sailing-rowing men-of-war and merchantmen, and to some types of small boat as well. The men-of-war of Phoenicia, ancient Greece, and other ancient maritime nations were galleys fitted with rams, and were in use as early as 850 B.C. The earliest galleys probably were long, narrow, open boats of shallow draft and with short decks at the bow and sometimes at the stern, with a narrow gangway extending down the center of the hull over the thwarts of the rowers. The oars pivoted on the gunwales or through oar ports cut in the topsides of the hull. A row of oarsmen sat on each side, protected from enemy missiles, at least to shoulder height, by a light, open rail on which were hung their shields or, in some instances, hides or heavy woven material.

Greek vase paintings show that these single-level, or one-banked, vessels had as many as twenty oars on a side and were from about 75 to 80 ft. long. The maximum number of oars on a side in a single-banked galley appears to have been twenty-five; such a galley would have been somewhat more than 100 ft. in length.

Multibanked Gallies. Ancient people could not build long hulls, and as a result they began to employ two banks of rowers on a side. This



Roman bireme man-of-war. From a marble relief (about 30 B.C.) in the Vatican collection.

innovation led to a marked increase in freeboard. The earliest two-banked galleys apparently had two decks, with oarsmen on each. Later, to reduce freeboard, galleys were built with the upper bank seated inboard of and between the rowers of the lower bank. Thus, the seats of the upper bank did not have to be above the heads of the lower bank. The two-banked galley was rowed with one man to the oar. As early as the time of the Assyrian Empire (about 1700–600 B.C.), two-banked galleys were built with a complete fighting deck above the upper bank of oarsmen. Single-banked galleys with such decks also are shown in early Greek vase paintings.

The desire to increase the speed and ramming power of the galley led to the introduction, sometime before 500 B.C., of three-banked galleys. This type was employed by ancient Greece, Rome, and other Mediterranean maritime nations. Considerable controversy exists regarding the seating arrangement of the oarsmen in these galleys. Enough evidence seems to exist, however, to assume that the lowest bank of oarsmen sat close to the side of the hull and rowed through oar ports 30 to 36 in. above the waterline, using possibly shorter oars than the other banks. The second bank rowed over the gunwale or through gunwale oar ports and sat inboard of the lower bank and between a pair in the lower bank. The third-bank oarsmen sat

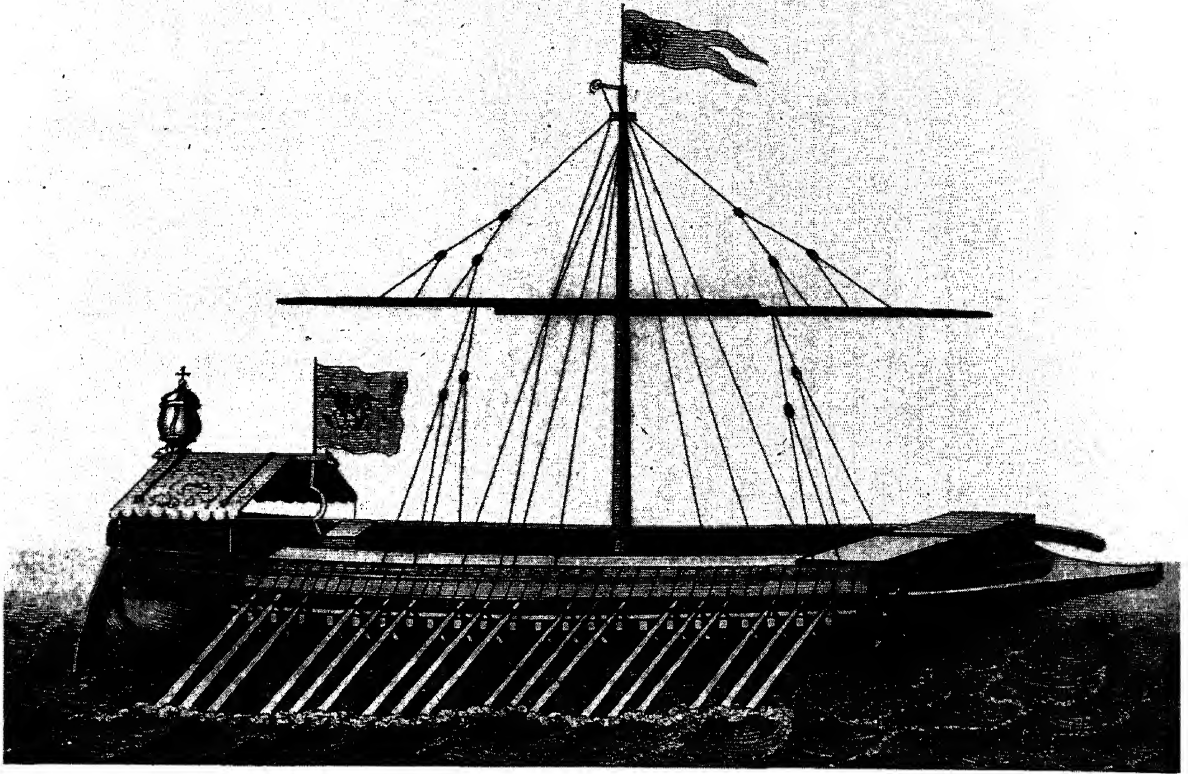
above and perhaps a little outboard of the lowest bank and between pairs of oarsmen in the second bank. The oars of the third bank apparently pivoted on an outrigger, or rowing frame, constructed by projecting the deck beams outboard and capping them with heavy timber.

The Athenian three-banked galley, called usually trireme, had fifty-four oarsmen in the lowest, or thalamite, bank, fifty-four in the second, or zygitic, bank, and sixty-two in the uppermost, or thranite, bank. Such a galley would have a length of about 128 ft. and a beam of perhaps 15 ft. at the waterline and would draw $3\frac{1}{2}$ to $4\frac{1}{2}$ ft. of water.

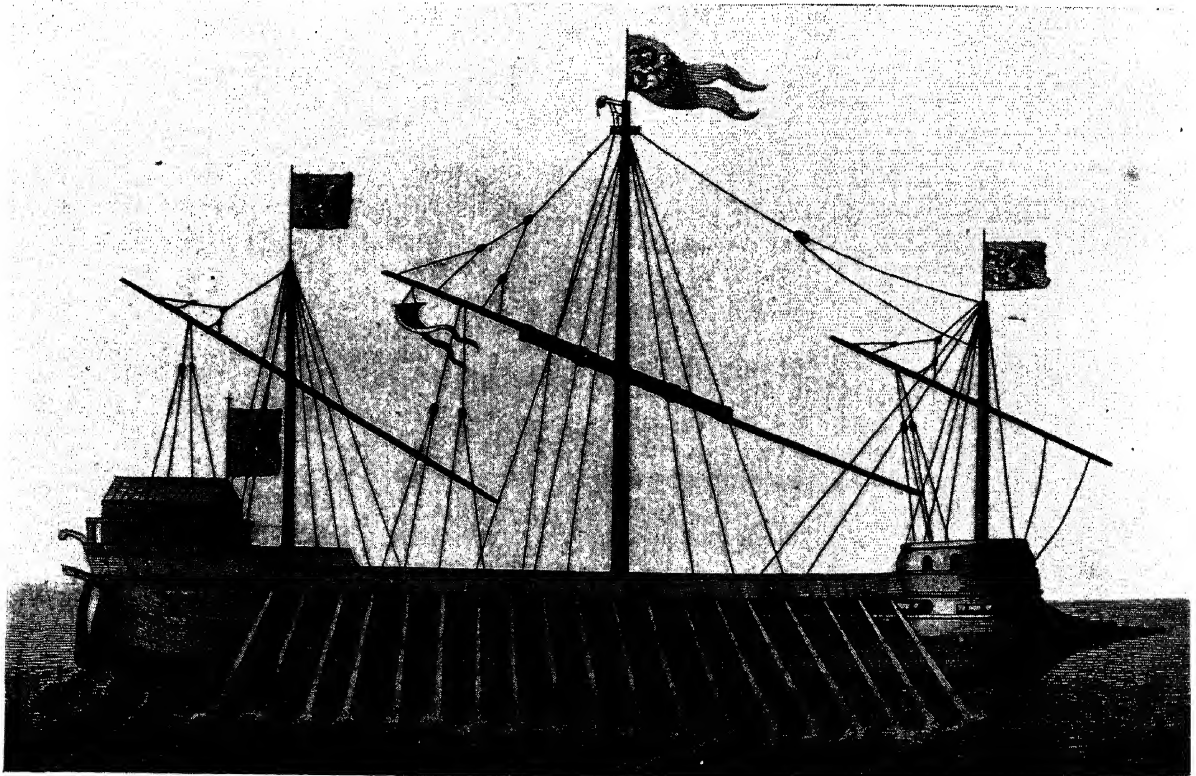
The early galleys appear to have been fitted with a single mast and sail, placed a little forward of amidships; some of the later three-banked galleys had two or three masts and sails, which were struck before going into battle. When cruising, the two- and three-banked vessels commonly used only one bank, the oarsmen working short watches so that all did not become tired at the same time.

About 325 B.C. four- and five-banked galleys (quadriremes and quinqueremes) appeared. How the oarsmen and oars were arranged in these craft and in the later multibanked ships is not known with certainty, but it seems improb-

GALLEY



Above: A Venetian galley of the 14th century. Below: A Venetian galley at the time of the Battle of Lepanto, 1571.
Both pictures, Mariners Museum, Newport News, Va.



able that the oar-per-man arrangement of the three-banked ships was continued in the four- and five-banked ships.

The later multibanked ships, ranging from the hexeris (six banks) to the tessaraconter (forty banks), appear to have been cumbersome and inefficient. In any event these craft were replaced by the Liburnian galley in the 3rd century A.D. The Liburnian galley was a relatively small vessel designed for speed and using two banks of oars on a side and a large sail. Long a favorite cruiser with the Romans, it was used by them in 31 B.C. at the Battle of Actium (see ACTIUM, BATTLE OF).

Middle Ages and Later. Among the types developed in the Middle Ages were the Byzantine dromond, a fast, two-banked sailing galley having twenty-five oars on a side; and the so-called Italian galley, which had oars on one level and in which one, two, or three men sat on the same bench to row, each with his own oar. The bench was canted to the centerline of the hull and raked from the centerline aft. The Italian galley carried 120 oarsmen and from 40 to 50 soldiers and sailors. It had a single mast and a triangular, lateen sail, a length of about 128 ft. and a beam of 16½ to 17 ft., and drew 4 to 4½ ft. of water, fully loaded. The hull had only about 2 ft. freeboard to the deck, which was heavily crowned and watertight, except at hatches near the centerline. At the bow, in the fore end of the rowing frame, was a deck structure in which heavy missile weapons such as catapults and ballistae were located. The crew lived on deck and the officers were quartered at the extreme stern in a raised cabin with a heavily crowned roof.

In the 13th century the so-called tarida, a galley nearly twice as wide as the Italian type, appeared. Equipped with two masts and carrying about 150 oarsmen, it was used as a transport. Merchant galleys, from 150 to 170 ft. long and with a beam of 18 to 23 ft., were introduced also. These vessels usually had three masts. By the middle of the 16th century the ordinary galley had an overall length of some 165 ft., a waterline length of 131 ft., a beam of about 18 ft., and a draft of 4½ ft. loaded. There were 150 rowers, and the total crew aboard aggregated from 220 to 230 men. The rowing arrangement remained unchanged, but the oars were longer and counterbalanced. The galleys of this period carried three to five heavy guns, pointed forward, and a number of pivoted, small, light guns.

Another 16th-century development was the galleass, a three-masted rowing-sailing ship, about 165 ft. long, with forty-five to forty-nine

oars, up to 350 rowers, and a total crew of about 700 men.

The Battle of Lepanto (see LEPANTO, BATTLE OF) in 1571 was the last of the great galley battles; thereafter the naval importance of this type of ship steadily declined. The rowing man-of-war played a subordinate role in subsequent battles, and by the last half of the 18th century the naval galley was no more than a small gunboat employed in inland waters and in coastal defense.

Galleys continued in use as merchantmen, however. Merchant galleys were built in New England for the North Atlantic trade at the end of the 17th century and in the Mediterranean and Baltic countries as late as the first quarter of the 19th century.

H.I.C.
GALLI-CURCI, Amelita (1889–1963), Italian coloratura soprano, born in Milan. She studied harmony, composition, and the piano at the Royal Conservatory, Milan. She was, however, largely self-taught as a vocalist, using phonograph records of her voice as a means of discovering defects of tone and delivery. She made her operatic debut in 1909 at the Teatro Costanzi, Rome, in the role of Gilda in *Rigoletto*, by the Italian composer Giuseppe Verdi (q.v.). During the following seven years she sang in Spain, Italy, and South America. She made her first operatic appearance in the United States in Chicago as a member of the Chicago Opera Association, again singing the role of Gilda. Her first appearance in New York City was in the title role of *Dinorah* by the German composer Giacomo Meyerbeer (q.v.), at the Lexington Opera House in 1918. She remained a member of the Chicago company until 1925. Meanwhile she had made her debut at the Metropolitan Opera House in New York City in 1920, singing the role of Violetta in Verdi's *La Traviata*. She remained a member of the Metropolitan Opera Company until 1930, when illness forced her to retire from the operatic stage. In 1921 Galli-Curci became a United States citizen.

One of the most renowned coloratura sopranos of all time, Galli-Curci appeared in operas by French and German composers as well as in those from the Italian repertory. She sang the title role of the opera *Lakmé* by Léo Delibes and Juliette in *Roméo et Juliette* by Charles François Gounod; she appeared as Sophie in *Der Rosenkavalier* by Richard Strauss. Her other roles in Italian operas included Rosina in *The Barber of Seville* by Gioacchino Antonio Rossini, Mimi in *La Bohème* by Giacomo Puccini, Elvira in *I Puritani* by Vincenzo Bellini, and Lucia in *Lucia di Lammermoor* by Gaetano Donizetti. She was also a well-known concert artist



Opera star Amelita Galli-Curci in the role of Violetta in La Traviata.
Brown Brothers

as a result of her tours of the U.S. and Europe during the 1920's. Her art is preserved in recordings, which rivaled those of the Italian tenor Enrico Caruso (q.v.) in popularity when they were originally issued.

See separate articles on composers mentioned.

GALLIENI, Joseph Simon (1849–1916), French soldier and colonial administrator, born in Saint-Béat, and educated at the military academy of Saint-Cyr. From 1877 until 1881 he participated in the explorations and military activity in the upper Niger R. region which resulted in the extension of French influence in western Africa. In 1886, after three years in Martinique, he became governor of Upper Senegal. In 1896, when Madagascar became a French colony, Gallieni was appointed resident general of the island, later becoming general and retaining that post until 1905. He established firm French control of Madagascar and instituted a program of economic development. On his return to France he was made general of a division, and in 1906 was named military governor of Lyon. At the beginning of World War I, Gallieni was chosen to head the military government of Paris. He is credited with persuading General Joseph Jacques Césaire Joffre (q.v.) to attack the Germans on the line of the Ourcq R. in the first Battle of the Marne; see MARNE, BATTLE OF THE. During

that battle Gallieni dispatched several thousand troops from Paris, using every available means of transportation, including taxicabs, to reinforce the army of General Michel Joseph Maunoury (1847–1923). For this action, which resulted in the repulse of the German right flank under General Alexander von Kluck (1846–1934), Gallieni was called the “Savior of Paris”. In 1915 he was made minister of war in the cabinet of Premier Aristide Briand (q.v.), but ill health caused him to resign in 1916. The title of marshal was awarded posthumously to Gallieni in 1921.

GALLIENUS, Publius Licinius Egnatius (d. 268 A.D.), Emperor of Rome (253–268). He was made joint ruler on the accession of his father, Valerian (q.v.), in August, 253. In 258 Gallienus defeated the Alamanni (q.v.), a group of German tribes who were making incursions into the Roman provinces along the Danube R. The Alamanni rose again, however, and forced their way into Italy, where Gallienus gained a second victory over them near Mediolanum (now Milan). Meanwhile, Valerian had been engaged in wars with Shapur I, Sassanid King of Persia (r. 241–72), by whom he was taken prisoner in 260 and put to death. Gallienus then became sole emperor, but in name only, because self-appointed rulers arose in all outlying parts of the Roman Empire. For this reason the period is known in history as the “Reign of the Thirty Tyrants”. To use his troops most effectively, Gallienus established a highly mobile cavalry force that was retained by his successors. During an attack on Mediolanum, which was held by a usurper, Gallienus was killed in a plot instigated by some of his officers.

GALLINULE, common name for any of a number of species of birds of the Rail family. Gallinules are similar in appearance to coots, but their toes usually have an undivided marginal membrane. This membrane and the great length of the toes enable the gallinules to swim powerfully. About thirty species of gallinules are generally recognized. Two occur in the United States. The Florida gallinule, *Gallinula chloropus*, sometimes regarded as a variety of the European gallinule, is brownish-olive above, grayish beneath, and has a red bill. It is a little more than a foot long. It is found in the western U.S. from California and Arizona south through western Mexico; in eastern North America from Ontario and Québec south through eastern Mexico, Central America, and the West Indies to northern Chile and Central Argentina. The purple gallinule, *Porphyryla martinica*, is olive-green above and purplish-blue in the under-

GALLIPOLI AND DARDANELLES CAMPAIGN

parts. It is about the same length as the Florida gallinule, and is found from South Carolina to South America.

The common gallinule *G. chloropus*, is a European species. It is olive-brown above and gray underneath. It is widely distributed in Europe, and in England is known as the water hen or moor hen. It nests near the water. The eggs, usually from seven to ten in number, are brown, speckled with red.

GALLIPOLI, anglicized name of Gelibolu (q.v.) in Turkey.

GALLIPOLI AND DARDANELLES CAMPAIGN, combined British-French naval and military undertaking in 1915–16, during World War I, designed to force the Dardanelles and Bosphorus straits and to capture Constantinople (now Istanbul) from Turkey. The immediate objectives were to supply Russia with munitions, war matériel, and other assistance, open a vital line of communication for grain and food supplies from the Black Sea to the Mediterranean, win Bulgaria to the side of the Allies, and strengthen the prestige of the Allies in the Middle East. The campaign was begun in February, 1915, exclusively as a naval venture. A British-French fleet commanded by the British officer Vice Admiral Sir Sackville Hamilton Carden (1857–1930) was concentrated off Limnos Island in the northern Aegean Sea, about 60 mi. from the entrance of the Dardanelles Strait, which was heavily mined and guarded on both sides by Turkish forts. Attacks were launched against the forts on Feb. 19 and Feb. 25, and gun emplacements were silenced and demolished, except at Kumkale (Kum Kale), on the Asian shore at the mouth of the strait, where the landing party was repulsed. The Allies swept the strait clear of mines, and on March 4 attacked Çanakkale (Chanak), also on the Asian shore, but were repulsed by concentrated fire from concealed Turkish positions along both shores. Carden resigned, and was replaced by Rear Admiral Sir John de Robeck (1862–1928). De Robeck launched a new attack on March 18, 1915, which resulted in the defeat of the Allied fleet.

The Allied high command decided that land forces would have to assume the dominant role in the campaign if the Allies were to obtain possession of the strait. Prior to the naval defeat, Allied ground forces under General Sir Ian Stan-dish Monteith Hamilton (q.v.) had been stationed on Limnos. Hamilton was unable, however, to initiate land operations immediately because of the wide dispersion of his troops, and a month was lost in amassing transports in accordance with tactical requirements. The Al-

lied forces began their landings on the morning of April 25, under exceedingly difficult conditions. Six Turkish divisions commanded by the German general Otto Liman von Sanders (1855–1929) were positioned effectively on the Gallipoli (Gelibolu) Peninsula. The Allied landing force consisted of the British 29th and Royal Navy divisions, an Australian and New Zealand division, a French colonial division, and the Assyrian Jewish Refugee Mule Corps. The British landed at five points on the peninsula: on both sides of Cape Helles, at Martolimanı about 2 mi. east of the cape, and at two points on the Aegean coast. Three of the landings were carried out without difficulty, one achieved a foothold with heavy losses, and one was an almost complete failure. During the night of April 25–26, in spite of further heavy losses, the Allies reinforced several of their critical positions and consolidated their beachheads. The French landed at Kumkale but were unable to advance, and on April 27 withdrew across the strait to the west coast of the peninsula. The Australians and New Zealanders landed a short distance north of Gaba Tepe (Kaba Tepe), farther up the west coast. Early in May the Allies were reinforced by the British 42nd Division, an Indian brigade, and the French 2nd Division. The Turks meanwhile established strong defenses at Gaba Tepe and on the east coast of the peninsula, and a trench-warfare stalemate developed. In July and August the Allies received reinforcements of five divisions, their artillery was strengthened, and ammunition supplies were improved. With the arrival of the fresh divisions, Hamilton secretly deployed a concentration of troops to the mountainous region of Sarıbayır east of Gaba Tepe, and at Suvla Bay on the Aegean about 5 miles N.W. of Gaba Tepe. Neither landing operation was successful because, although a beach-head was gained at Suvla Bay, the Allies did not press the advantages they had gained initially. When von Sanders discovered the Allied tactic, he transferred his troops from Bulair to Suvla Bay. Again the Allies failed to take advantage of the weakened Turkish defenses, and instead engaged in extensive preparation for a new attack. Following the Allied failure in the early August offensive, the British and French governments planned to dispatch sufficient reinforcements to Gallipoli to gain a numerical and tactical superiority. The plan was dropped, however, when the turn of events in the Balkans became critical for the Allied forces. Between September and December the French and British governments considered the withdrawal of troops from Gallipoli, and finally on Dec. 8, 1915, orders were

GALLIUM

dispatched to Sir Charles Carmichael Monro (1860–1929), who had succeeded Hamilton, to withdraw from Suvla Bay and Gaba Tepe. One week later, orders were received to evacuate Cape Helles. Both withdrawals were military and naval achievements, being accomplished with minimal losses in men and material. The evacuation was completed on Jan. 9, 1916.

The struggle for the Dardanelles ended in complete failure for the Allies. Some of the evacuated troops were sent to Salonika, but most were dispatched to Egypt for reassignment to other fronts. The Allies and Turkey each lost about 100,000 men killed, wounded, or missing. The episode resulted in an interruption in the career of the British statesman Winston Leonard Spencer Churchill (q.v.), who as first lord of the admiralty had advised the invasion, and enhanced the reputation of the defending Turkish general Mustafa Kemal (see KEMAL ATATÜRK).

See also *WORLD WAR I: The Campaigns and Events of 1914–15: The Turkish Front*.

GALLIUM, element with at.no. 31, at.wt. 69.72, b.p. over 2100° C. (3812° F.), m.p. 29.78° C. (85.604° F.), sp.gr. 5.90 at 20° C., and symbol Ga. It is blue gray in color. Gallium was discovered spectroscopically by the French chemist Paul Émile Lecoq de Boisbaudran (1838–1912) in 1875, and isolated in the metallic state by him in 1876. It is the only metal other than mercury that is liquid at or near room temperature. It can be supercooled below its melting point to 58° C. without freezing. Like water, gallium expands on freezing.

The element is thirty-second in order of abundance in the crust of the earth. It occurs in small quantities in some varieties of zinc blende, bauxite, pyrite, magnetite, and kaolin. Gallium resembles aluminum in forming trivalent salts and oxides; it also forms a few divalent compounds. The low melting point and high boiling point of the metal are used to advantage in high-temperature thermometers.

GALLOWAY, Great Britain, district in s.w. Scotland, comprising the counties of Kirkcudbright and Wigtown. It was once a province and included a larger territory. The name Galloway, although still in use locally and historically, no longer has any political significance. The district was known to the Romans as Novantia, and its present name is derived from the Gaelic *Gall-Gael* ("Foreign Gaels"). The term was applied to its inhabitants because they were topographically separated from their northern kinsmen and preserved their identity as a distinct race until the 12th century, their language remaining unchanged until the 15th century. After the Roman

evacuation, in the 5th century A.D., Galloway came under the power of the Angles (q.v.), during which time its inhabitants were called the Picts of Galloway; later the area was conquered by the Norsemen (q.v.). In the 11th century Galloway was taken by Malcolm III MacDuncan, King of Scotland (d. 1093), who gave his son, later David I (q.v.), King of Scotland, the title earl of Galloway and united the territory to the kingdom of Scotland. The district is famous for the scenic beauty of its mountains, lakes, and moorland, and also for its fine pasturelands. A native breed of hornless sturdy black beef cattle bears the name Galloway.

GALLUP, town in New Mexico, and county seat of McKinley Co., on the Rio Puerco, near the Arizona boundary, about 160 miles N.W. of Albuquerque. The city, at an altitude of 6506 ft. above sea level, is served by railroad and has a municipal airport. Gallup is the center of a region producing coal, oil, and cattle. In addition, it is the trading center and market for the Navajo and Zuñi Indians. The Intertribal Indian Ceremonial, held each August at Gallup by about thirty Indian tribes, includes dances, athletic events, and exhibits of ancient and modern Indian art. In the vicinity of the town are the Navajo and Zuñi Indian reservations, the latter containing one of the largest pueblos in the Southwest. The Fort Wingate Indian School is situated 12 miles S.E. of Gallup, and El Morro National Monument (q.v.) is about 45 miles S.E. of the town. Gallup was settled about 1880 and incorporated in 1891. Pop. (1970) 13,779.

GALLUP, George Horace (1901–), American public-opinion analyst and statistician, born in Jefferson, Iowa, and educated at the University of Iowa. He was head of the department of journalism at Drake University from 1929 to 1931, professor of journalism and advertising at Northwestern University in 1931–32, and professor at the Pulitzer School of Journalism, Columbia University, from 1935 to 1937. Since 1932 he has directed research for many organizations; in 1935 he founded and became the director of the American Institute of Public Opinion, and a year later he founded the British Institute of Public Opinion. He was the originator of the statistical method of measuring the interest of readers in the features and advertisements of magazines and newspapers, and of determining public opinion on general issues. He extended his research to deal with the reactions of radio audiences, and founded the Audience Research Institute in 1939. He is best known for his surveys of public opinion on politics known as the Gallup Poll. See PUBLIC-OPINION RESEARCH.

GALLUS, Gaius Cornelius (d. 26 B.C.), Roman poet, soldier, and statesman, born in Forum Iulii (now Fréjus, France). After the death of the Roman general and statesman Gaius Julius Caesar (q.v.) Gallus supported Octavian, later Augustus (q.v.), Emperor of Rome. In 31 B.C. he commanded a division at the Battle of Actium, where the forces of Octavian defeated those of the Roman general Mark Antony (see ANTONIUS, MARCUS) and Cleopatra VII, Queen of Egypt (see under CLEOPATRA). Gallus was then sent into Egypt by Octavian; he inflicted another defeat on Antony and captured Cleopatra. Upon her death in 30 B.C., Gallus was named first prefect of the newly proclaimed Roman province of Egypt. After a successful administration of four years, he was denounced by his enemies to Augustus, and the Roman senate deprived him of his rank and lands and ordered his banishment; he thereupon committed suicide. Gallus was the author of four books of elegies, none of which survives; he was characterized by the Roman poet Ovid (q.v.) as the greatest of the Roman elegiac poets.

GALLUS, Gaius Vibius Trebonianus (205?–253 A.D.), Emperor of Rome (251–53). He served under Emperor Decius (q.v.) in the campaign against the Goths (q.v.) in 251, and is said to

have contributed by his treachery to the death of Decius. Gallus thereupon became emperor, and shortly afterward purchased peace with the Goths by agreeing to let them retain the booty and captives they had acquired in their war with Rome and by pledging to pay them a fixed annual tribute. In 253 the Roman Empire was again invaded by the Goths, but they were defeated in the Roman province of Moesia west of the Black Sea by the provincial governor Aemilianus (206?–253), whose troops then proclaimed him emperor. Gallus marched forth to suppress the insurrection, but was killed by his own soldiers before his army and that of Aemilianus could meet.

GALSWORTHY, John (1867–1933), British novelist and playwright, born in Kingston Hills, Surrey, England, and educated at Harrow School and New College, University of Oxford. He was admitted to the bar in 1890, but soon abandoned the law for writing. Galsworthy wrote his early works under the pen name John Sinjohn. He was one of the outstanding English novelists

The Forsyte Saga by John Galsworthy, adapted for British television as a continuing series, achieved great success in the U.S. when it was presented over the educational television network, WNET. Here, the whole Forsyte cast gathers for a group portrait. WNET-TV



GALT

and dramatists of the early 20th century. His fiction is concerned principally with English upper middle-class life; his dramas frequently find their themes in this stratum of society, but also often deal, sympathetically, with the economically and socially oppressed, and with questions of social justice. Most of his novels deal with the history, from Victorian times through the first quarter of the 20th century, of an upper middle-class English family, the Forsytes. The principal member of the family is Soames Forsyte, who exemplifies the drive of his class for the accumulation of material wealth and in whom that drive often conflicts with human values. The Forsyte series includes *The Man of Property* (1906), the novelette "Indian Summer of a Forsyte", published in the collection *Five Tales* (1918), *In Chancery* (1920), *Awakening* (1920), and *To Let* (1921); the five titles were published as *The Forsyte Saga* (1922). The Forsyte story was continued by Galsworthy in *The White Monkey* (1924), *The Silver Spoon* (1926), and *Swan Song* (1928), which were published together under the title *A Modern Comedy* (1929). These were followed in turn by *Maid in Waiting* (1931), *Flowering Wilderness* (1932), and *Over the River* (1933), published together posthumously as *End of the Chapter* (1934). Among the plays by Galsworthy are *Strife* (1909), *Justice* (1910), *The Pigeon* (1912), *Old English* (1924), and *The Roof* (1929). Galsworthy was awarded the 1932 Nobel Prize in literature.

GALT, city of Canada, in Waterloo Co., Ontario Province, on the Grand R., 23 miles N.W. of Hamilton and 50 miles S.W. of Toronto. Industries include publishing, textile knitting, silk milling, metalworking, and the manufacturing of electrical and electronic equipment, shoes, paint, lumber, wood and plastic products, tools, and hardware. Founded in 1816 as Shade's Mills, the city was renamed in 1827 for the British author and pioneer in Canada, John Galt (see *under* GALT). Pop. (1971) 38,897.

GALT, name of a British family well known in literature and public service, including the following.

John Galt (1779–1839), author, born in Irvine, Ayr County, Scotland. He studied law briefly at Lincoln's Inn, London. Early in the 1820's he wrote a series of colorful novels of Scottish country life, including *The Ayrshire Legatees* (1820) and *The Annals of the Parish* (1821). In 1825 and from 1826 to 1829 he served in Canada as an official of the Canada Company, a land-development organization. During this period he founded the town of Guelph (now in Ontario). Shade's Mills (Ontario) was renamed Galt

in his honor in 1827. After his return from Canada to live in England and Scotland, he wrote many miscellaneous works, including *The Life of Lord Byron* (1830), a biography of his friend the British poet George Gordon Byron (q.v.), and *Lawrie Todd* (1830), the first novel to deal with Scottish settlers in Canada.

Sir Alexander Tilloch Galt (1817–93), Canadian statesman, the son of John, born in London, England, and privately educated. He emigrated to Canada in 1835 to join the British American Land Company as a clerk; he served as commissioner of the company from 1844 to 1855. In 1849–50 he held his first post as a public servant, representing Sherbrooke, a town in the province of Canada East (now Québec), in the newly established joint Canadian legislature; see CANADA: *History: British Rule to Confederation*. Reelected in 1853, he served until 1872 as a leading spokesman for the English-speaking minority of the province. From 1858 to 1862 and from 1864 to 1865 he was also minister of finance for the two parts of Canada. In 1867, when the confederation which he had long advocated was achieved, he was named minister of finance in the first government of the Dominion of Canada. He resigned, however, later the same year. Knighted in 1869, he served as first Canadian high commissioner to Great Britain from 1880 to 1883.

GALTON, Sir Francis (1822–1911), British scientist, born near Birmingham, England, and educated at King's College, London, and Trinity College, University of Cambridge. He traveled in Africa in 1844 and 1850, and wrote *Narrative of an Explorer in Tropical South Africa* (1853) and *Art of Travel* (1855). He made a study of meteorology and wrote *Meteorographica* (1863), the first book on modern methods of mapping weather.

Galton, a cousin of the British naturalist Charles Robert Darwin (q.v.), is best known for his work in anthropology and heredity and is considered the founder of the science of eugenics (q.v.). His interest in heredity led him to pioneer work in measurement of humans, that is, in the collection of statistics on height, dimensions, strength, and other characteristics of large numbers of people. He devoted special attention to fingerprints and devised a method of identification by fingerprinting (q.v.). He also demonstrated fundamental techniques in statistical measurement, notably in the calculation of the correlation between pairs of attributes; see STATISTICS: *Correlation*. Galton was knighted in 1909. Among his works are *Hereditary Genius* (1869), *Inquiries into Human Faculty* (1883),

Natural Inheritance (1889), and *Finger Prints* (1892).

GALVANI, Luigi (1737–98), Italian physiologist, born in Bologna. He was a medical student and later professor of anatomy at the University of Bologna. His accidental discovery that the leg of a frog twitched when touched with an electrically charged scalpel led Galvani to perform a



Luigi Galvani

New York Public Library

series of experiments for which he is famous. He caused a frog's leg to contract by putting two wires of different metals into the muscle of the leg, and attributed this effect to the generation of a current of electricity. Although his conclusion that electricity was generated by the muscles and nerves of the animal was erroneous, Galvani's name is still associated, in the word "galvanism", with current electricity and, in the word "galvanization", with the applying of an electric current to the human body. See *ELECTRICITY: History*.

GALVANIZED IRON, iron or steel coated with a layer of zinc (q.v.) for protection against corrosion. Zinc is applied with greater ease and at lower cost than other metallic coatings such as tin, chromium, nickel, or aluminum.

The most widely used method of galvanizing is the hot dip process. The iron is pickled (immersed in acid) to remove rust, dirt, and grease.

It is then washed and dipped into the spelter, that is, molten zinc. In the sherardizing process, the article to be galvanized is covered with zinc dust and heated in a tightly closed drum for several hours at 300° to 420° C. (572° to 788° F.). Other methods of galvanizing iron consist of depositing the zinc electrolytically, and applying molten zinc in the form of a fine spray.

GALVANOMETER. See *ELECTRIC METERS: Measurement of Current*.

GALVESTON, city and port of entry in Texas, and county seat of Galveston Co., on the E. end of Galveston Island, in the Gulf of Mexico at the mouth of Galveston Bay, 48 miles S.E. of Houston. Galveston is connected to the mainland, a distance of approximately 2 mi., by two concrete causeways, and is served by railroads, ships, and barges on the Intracoastal Canal from New Orleans, La., to Corpus Christi, Texas, and major airlines. In addition, Galveston is the S. terminus of the Canada-to-Gulf and Meridian highways. A concrete seawall, 17 ft. high and 7½ mi. long, protects the S. side of the city, fronting on the gulf, from flood.

Galveston is one of the principal seaports of the United States. Vast quantities of sulfur, cotton, wheat, flour, metals, and sugar are exported from the city, and bananas and raw sugar are imported from Latin America. The harbor, on the N. side of the city, has a frontage on Galveston Channel of 6½ mi., with facilities for about a hundred oceangoing ships. Waterfront warehouses cover several million square feet, and large elevators provide storage for millions of bushels of grain.

Galveston is noted also for its industrial establishments and commercial fisheries. Industrial establishments include oil refineries, shipbuilding yards, dry docks, machine shops, cotton compresses, flour mills, rice mills, and breweries. Galveston is the headquarters of one of the largest customs districts of the U.S., and is a center for banking and insurance. Among the educational and medical institutions in the city is the medical branch of the University of Texas, which includes the School of Medicine (established in 1891), the John Sealy College of Nursing, the John Sealy Hospital, and the State Hospital for Crippled Children. This university branch is the only State-endowed medical school in Texas; it is noted for the study of tropical medicine. Galveston is also the site of Saint Mary's Infirmary, founded in 1866.

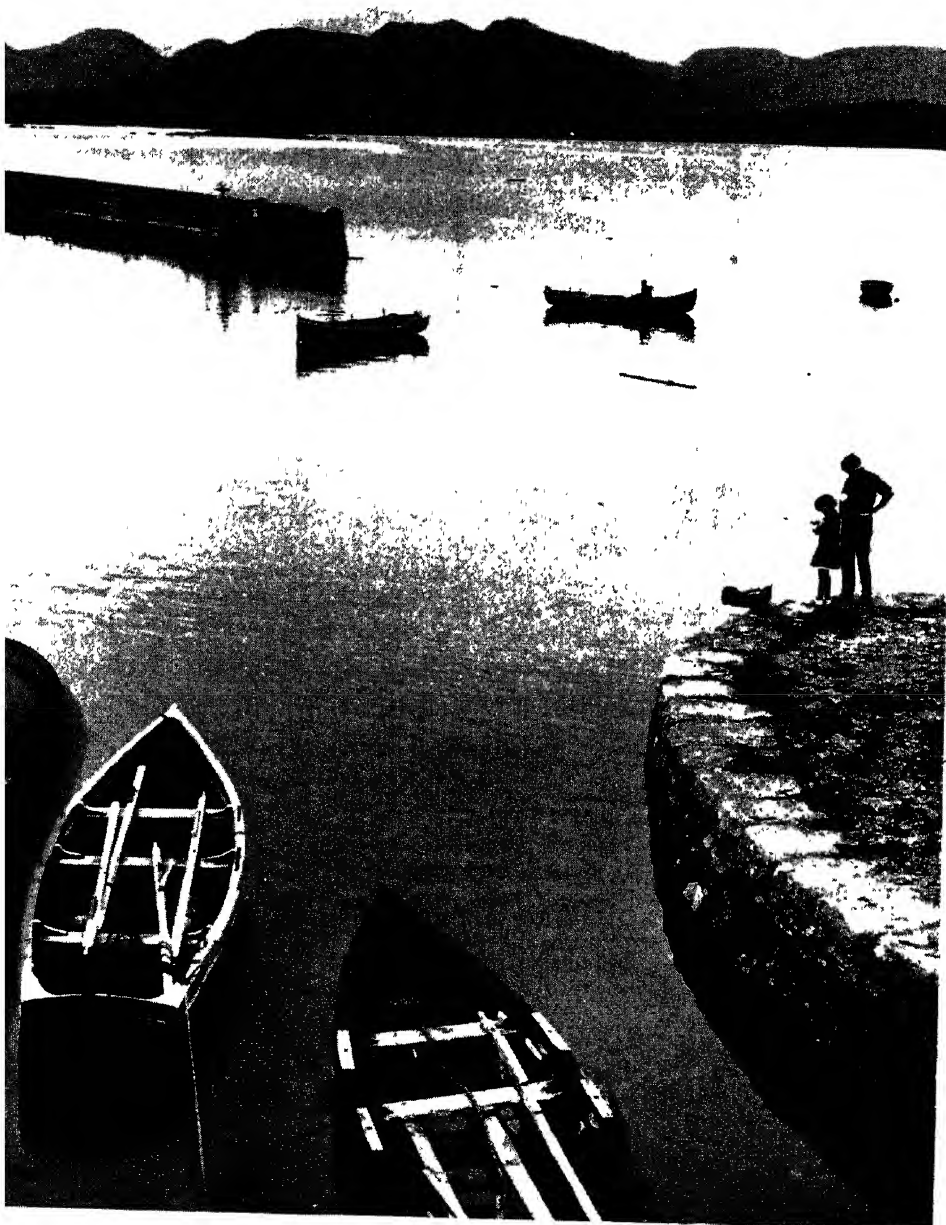
History. Galveston Bay and Island were named about 1782 for Bernardo de Gálvez (1746?–86), Spanish governor of Louisiana. In 1816 the island was used by a Spanish soldier Francisco

GALVESTON

Javier Mina (1789–1817), as his headquarters while fighting on the side of Mexican revolutionists trying to free Mexico from Spain. Later the island became a rendezvous of the pirate Jean Laffite (q.v.), who remained on it with his band until driven out by an American warship about 1821. In 1837 the first settlement from the U.S. was established on the island, and in 1839, following the organization of the county of Galveston, the city was incorporated under the Republic of Texas. About this time Galveston began to grow in importance as a port, and dur-

ing the American Civil War it was the most important Confederate port on the gulf. The Federal fleet maintained a blockade against Galveston throughout the war, but the city remained in Confederate control, with the exception of a few months in 1862, until June, 1865. The Confederates were successful in two naval engagements fought in Galveston harbor on Jan. 1 and Jan. 21, 1863. A fire ravaged the city in 1885, and on Sept. 8, 1900, a West Indian hurricane, which blew steadily for eighteen hours with a velocity of 135 m.p.h. at its peak, drove a

A peaceful scene at Roundstone, County Galway, a town on one of the many inlets along the coast of the Connemara Peninsula.
Irish Tourist Board



tidal wave across the city, inundating it to a depth of 4 to 16 ft. Property worth about \$17,000,000 was destroyed, and more than 5000 lives were lost. To increase the effectiveness of the city government in meeting the massive problems of reconstruction, Galveston adopted a charter in 1901 giving the city a commission form of government (see MUNICIPAL GOVERNMENT). The city was rebuilt, and protection was provided against further storm disasters by the construction of a seawall $1\frac{1}{2}$ ft. higher than the high-water mark of the storm, and the raising of the grade of the city from 1 to 15 ft. above its former level. As a consequence, equally violent hurricanes that occurred in 1915 and 1961 caused fewer deaths in Galveston. Pop. (1960) 67,175; (1970) 61,809. See also TEXAS CITY.

GALWAY, maritime county of the Republic of Ireland, in Connaught Province, bounded on the w. by the Atlantic Ocean. After County Cork, Galway is the largest of the Irish counties.

Most of the eastern part of County Galway is a plain with extensive bogs, but Connemara Peninsula in the w., extending s. from County Mayo to Galway Bay, is rugged in terrain, with Benbaun Mt., in the Twelve Pins (Bunnabeola) group, reaching a height of 2395 ft. above sea level. The Galway coast has many inlets and is dotted with islands. The county has numerous lakes, the largest being Lough Corrib, 27 mi. long. The economy of County Galway is largely based upon the growing of wheat, oats, barley, and potatoes, and the raising of sheep, pigs, and poultry. Fishing, gathering of kelp, and the quarrying of limestone, gravel, marl, and black and red marble are also important.

The largest towns in the county are the county town Galway (pop. 1971, 27,726), Ballinasloe (5969), Tuam (3808), and Loughrea (3075). Several ancient encampments, burial sites, and ruins of castles and monasteries are in the county, and Tuam is the site of a castle built in 1161 by Roderic O'Connor, King of Connaught (1116–98).

Area, 2293 sq.mi.; pop. (1971) 148,220.

GALWAY, town and seaport in the Republic of Ireland, in Connaught Province, and county town of County Galway on the n. shore of Galway Bay, about 125 miles w. of Dublin. The town of Galway, in addition to exporting wool and agricultural produce from its hinterland, possesses fisheries, distilleries, iron foundries, flour and corn mills, marble-polishing works, and brush and bag factories. It is also the seat of a Roman Catholic diocese, and the site of University College, a constituent college of the National University of Ireland.

The older section of the town is built in an irregular fashion, and many of the older buildings are Spanish in architecture. The new town, with spacious streets, is built on rising ground, which slopes gradually toward the bay and the Lough Corrib. Among the churches in Galway is Saint Nicholas, a cruciform structure dating from 1320. Walls, fragments of which remain, were built around the town about 1270, and the commercial development began about that time. From the 13th to the 17th centuries, Galway had considerable trade with Spain. Pop. (1971) 27,726.

GAMA, Vasco da (1469?–1524), Portuguese explorer and navigator, first European to reach India by the sea route, born in Sines, Alemtejo (now Baixo Alentejo). In his youth he participated in the wars against Castile. Commissioned



Vasco da Gama

Granger Collection

by Emanuel (q.v.), King of Portugal, to reach India by sea, da Gama sailed from Lisbon with four ships on July 9, 1497. In November he rounded the Cape of Good Hope (first rounded in 1486 by the Portuguese navigator Bartholomeu Dias (q.v.) and anchored at Malindi on the east coast of Africa. With the aid of a pilot secured through Indian merchants in that port, da Gama directed his course eastward and on May 20, 1498, reached Calicut (now Kozhikode; q.v.) on the Malabar Coast of India. Because of the

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hostility of the Muslim merchants, he could not establish a Portuguese trading station there. After fighting his way out of the harbor of Calicut, he returned to his native land in 1499. Da Gama was welcomed with praise, rewarded financially, and permitted to employ the prefix Dom with his name. To follow up the discoveries of da Gama, the Portuguese navigator Pedro Álvares Cabral (q.v.) was immediately dispatched to India and in Calicut established a Portuguese trading post. When news reached Portugal that those stationed in Calicut by Cabral had been massacred, da Gama, who had been given the title of admiral of India, was sent to avenge that act. On the route to Calicut he established Portuguese colonies at Mozambique and Sofala (now part of Mozambique), in east Africa. After arriving in Calicut, da Gama subdued the inhabitants and forced the raja to make peace. Bearing a rich cargo of spice, he left India and sailed back to Portugal in 1503. For the next twenty years he saw no active sea duty. He received the title of Count of Vidigueira in 1519, and in 1524 was named viceroy and sent to India to correct the mounting corruption among the Portuguese authorities there. He reached India in the fall of 1524, but died in Cochin only three months after his arrival.

GAMALIEL, name of several Jewish figures. In the Old Testament, Gamaliel is mentioned in Numbers as a prince of the tribe of Manasseh (q.v.). In Jewish history of the New Testament period, Gamaliel is the name of a number of rabbis who were descendants of the rabbi and teacher Hillel (q.v.). Of these the most notable were the following.

Gamaliel the Elder (d. about 50 A.D.), rabbi of the Pharisees, president of the Sanhedrin (qq.v.) and the first rabbi to be honored with the title of *rabban* (Heb., "teacher" or "master"), afterward granted to all heads of the Sanhedrin who were descendants of Hillel. Gamaliel was a renowned teacher of the Law (see TORAH). The New Testament records Gamaliel's name in two instances: in Acts 5:34-40, he advises the Sanhedrin to treat the disciples of Jesus Christ (q.v.) with moderation; in Acts 22:3, Saint Paul (q.v.) boasts that the great rabbi was his instructor in the Law.

Gamaliel of Jabneh, or **GAMALIEL THE YOUNGER** (d. 115?), scholar, grandson of Gamaliel the Elder. He was the head of the school of Jabneh, a town near Jaffa (now Tel Aviv-Jaffa, Israel), which became the center of Judaism and Jewish studies after the destruction of Jerusalem in 70 A.D. Gamaliel's authority over the Jews was recognized by the Romans, who designated him

"patriarch". He dedicated himself to the preservation of Judaism and made notable contributions to its ritual; they included a revision of the eighteen Benedictions recited thrice daily by orthodox Jews and the substitution of the present simple Passover (see PESACH) service for the paschal sacrifice forbidden after the destruction of the Temple.

See PRAYER, JEWISH: *Daily Services*; TEMPLE: *Temple at Jerusalem*.

GAMBA, VIOLA DA. See VIOL.

GAMBETTA, Léon (1838-82), French lawyer and statesman, born in Cahors, and educated in law in Paris. He began to practice in 1860 and, through his speeches and his articles in the *Revue Politique et Littéraire* ("Political and Literary Review"), soon became known as a leader of the opposition to the French imperial regime. In 1868 while defending a journalist who had been banned by the government, Gambetta attacked, in a speech that made him famous, the coup d'état of 1851 by which Louis Napoleon Bonaparte became Napoleon III (q.v.), Emperor of France, the following year.

Gambetta was elected to the chamber of deputies in 1869. Although he first opposed the declaration of war against Prussia in 1870, he worked vigorously for the French cause once war had been declared; see FRANCO-GERMAN WAR. On Sept. 4, 1870, two days after the disastrous Battle of Sedan in which Napoleon III was captured by the Germans, the Parisian republicans, headed by Gambetta, proclaimed the establishment of the Third Republic. Gambetta escaped from besieged Paris in a balloon, established headquarters at Tours, and attempted to reorganize the French army in the provinces. In Tours and later in Bordeaux, he assumed the direction of French affairs and for five months was, by popular consent, dictator of France. Urging the French to fight on, Gambetta regarded the surrender (at Metz) of the French military leader Achille Bazaine (q.v.) as an act of treason, and resigned from the provisional government after the capitulation.

Gambetta was one of the most radical members of the national assembly. To disseminate his republican beliefs, he founded *La République Française*, which became one of the most influential newspapers in France. He strongly opposed attempts to restore the monarchy and fought against the clerical group that wished to restore the temporal power of the pope. After the resignation of President Louis Adolphe Thiers (q.v.) in 1873, Gambetta tempered his radical views, although he resisted any attempts to make the government less republican. His

fiery speeches were celebrated; in 1877 he was twice prosecuted for violence of speech and was imprisoned for three months. His popularity and political strength never wavered, however. When François Paul Jules Grévy (q.v.) was elected president of France in 1879, Gambetta became president of the Chamber of Deputies. In 1881 Gambetta became premier of France. His ministry, however, lasted only sixty-six days because his policies, which aimed at the formation of a strong executive government, were unpopular with almost all political factions. His death came as the result of an accidental pistol wound that aggravated an intestinal malady from which he had long suffered. Gambetta is considered one of France's most notable patriots, orators, and statesmen. His speeches were published as *Discours et Plaidoyers Politiques de Gambetta* ("Talks and Speeches for the Defense of Gambetta's Policies", 11 vol., 1880-85). **GAMBIA, THE, or GAMBIA**, republic within the Commonwealth of Nations. It is situated on the w. coast of Africa, enclosed on the N., E., and S. by Senegal and fronting the Atlantic Ocean on the W. It lies between lat. 13° N. and lat. 13°40' N. and long. 13°40' W. and long. 17° W. Gambia has an area of 4003 sq.mi.

THE LAND

Gambia extends for about 200 mi. inland from the Atlantic Ocean on both sides of the lower Gambia River (q.v.). It is only 20 mi. wide at its widest point. The river is lined with mangrove swamps. Beyond the swamps is savanna country.

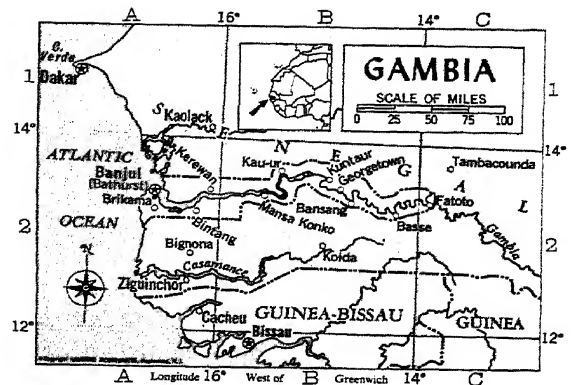
Climate. Gambia has a subtropical climate with distinct hot and cool seasons. During the cool season, from December to April, the cold, dry winds of the harmattan blow from the Sahara (q.v.). Temperatures during the year range from 45° F. to 110° F. The rainy season lasts from June to October. The average annual rainfall is 40 in.

Natural Resources. The main natural resources are agricultural. The soil is mostly poor and sandy, except in the riverine swamps, but is ideally suited for the cultivation of peanuts, upon which the economy is dependent.

Plants and Animals. The mangrove, fern oil palm, and rubber vine grow in profusion, and West African cedar and mahogany trees abound. The fauna includes the leopard, wild boar, crocodile, hippopotamus, and several species of antelope. Such game birds as the guinea fowl and sand grouse are plentiful.

THE PEOPLE

The majority of the inhabitants of Gambia are Muslim and live in farming villages. The Chris-



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Banjul (cap.)	A 2	Fatoto	C 2
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Brikama	A 2	Kontaur	B 2
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tian minority lives mainly in Bathurst, the capital, which is the seat of an Anglican and a Roman Catholic bishop.

Population. The population of Gambia (census 1963) was 315,486, making Gambia the least populous independent African country; the United Nations estimated (1970) 364,000. The overall population density is about 83 per sq.mi. (U.N. est. 1970). The tribal population comprises the Mandingo, the largest single tribe (130,000); the Fula (q.v.), who predominate in the E. part of the country (43,000); the Wolof (41,000), who live mainly in Banjul and the W. region; the Serahuli (21,000), whose rulers introduced Islam into the region in the 12th century and who are primarily traders and nomads; the Jola (22,000), who live in the W. region; and the small Aku community, partly descended from liberated slaves.

Banjul, formerly Bathurst, the capital, is the only seaport and large city. The 1973 census population of the capital was 39,476.

Religion and Language. About 85 percent of the people are Muslim. Most of the rest are followers of the traditional local animism (q.v.). A small minority (about 2 percent) are Christian. English is the official language. The principal vernacular languages are Wolof and Mandinka.

Education. Primary education is compulsory and relatively inexpensive. In the early 1970's Gambia had 94 primary schools, 17 junior secondary schools, and 5 senior secondary schools. Enrollment totaled more than 22,500 students. Other educational institutions included a teacher-training college, a vocational training center, and the Gambia School of Nursing,



The prime minister of The Gambia, Sir Dauda Jawara (seated behind small table), leads a discussion with the village authorities of Queenala during an election campaign.

United Nations

which was opened at Banjul in 1964.

THE ECONOMY

Gambia is dependent largely on the production of a single crop, peanuts. Recent annual budget figures show expenditures of about \$16,600,000 and somewhat lower revenues.

Agriculture and Fishing. About 85 percent of the population is engaged in agriculture. Rice and millet, as well as cattle, sheep, and goats, are raised for local consumption. Peanuts are grown primarily for export. In the mid-1970's the sale of peanuts and peanut oil accounted for over 95 percent of total exports by value (\$32,000,000). Other exports were vegetable oils, fodder, palm kernels, fish, hides, and beeswax. The government has introduced the raising of cotton, sisal, citrus fruits, and tobacco to diversify agricultural production. The coastal villages engage in fishing. In the mid-1970's about 600 tons of dried and smoked fish were exported annually.

Manufacturing, Currency, and Trade. Industry is limited primarily to the processing of peanuts and other local primary products and the building of fishing boats; however, in the late 1960's a soft-drinks factory, a distillery, a garment and shoe factory, a perfume and candle factory, and a cassava development project were established. By the mid-1970's the cassava development project was producing 8 metric tons of cassava per year. The unit of currency, adopted

in 1971, is the dalasi (2.18 dalasi equal U.S.\$1; 1978), consisting of 100 butut; it is issued by the Gambia currency board. Banks in The Gambia include the Standard Bank of West Africa, Ltd., and a branch of the International Bank for Commerce and Industry. Although Great Britain remains The Gambia's chief trading partner and provides the bulk of foreign aid, in the mid-1970's aid programs were developed with the United States, West Germany, many Arab nations, the Soviet Union, and the People's Republic of China.

Transportation and Communications. The Gambia R. is navigable for about 150 mi. from the Atlantic Ocean by oceangoing vessels of up to 3000 tons. The construction of a major road S. of the river has reduced the importance of the river as a major artery of transportation. There are no railroads in the country. An international airport is located at Yundum, about 17 mi. from Banjul. Radio Gambia operates daily on a somewhat limited schedule, as does one commercial station.

GOVERNMENT

The Gambia is a republic with a popularly elected president as head of state. He holds office during the term of parliament. When parliament is dissolved a general election must be held for a new parliament and a new president. The vice-president functions as leader of government business in parliament, which consists of a single house with thirty-two elected members, four chiefs elected by their peers, and four nominated members without vote.

The judicial system consists of a Supreme Court with unlimited jurisdiction, an appeal court, and subordinate magistrate courts. Civil actions between Muslim citizens are handled by special Muslim courts. Minor civil and criminal cases are tried in group tribunals.

HISTORY

Numerous tribes inhabited the region prior to the first settlement by Europeans, but no unified grouping existed. The Portuguese arrived at the mouth of the Gambia R. in the 15th century, but did not establish a settlement. Throughout the 17th century companies of European merchants secured trading charters to the area, but European activity was limited to the operations of a few individual traders. In 1821 the British settlements in the region were placed under the administrative control of Sierra Leone (q.v.). In 1888 The Gambia became a separate colony. The first elections based on universal suffrage were held in May, 1960. The colony became independent on Feb. 18, 1965, and on Sept. 21 was admitted to the United Nations. Sir Dauda Kairaba Jawara (1924–), former minister of education, became the first prime minister of the independent country. In a national referendum in 1970 the Gambian people voted in favor of a republican form of government. Jawara became the first president and was reelected in 1972 and 1977. Since the year of its independence The Gambia has been a member of the Organization of African Unity (q.v.).

GAMBIA, river of N.W. Africa, rising in the Futa Jallon Mts. in Guinea and flowing N.W. in Senegal and then W. through all of The Gambia, emptying into the Atlantic Ocean by a wide estuary near Saint Mary's Island, the site of Banjul, the capital of The Gambia. A sandbar at the mouth does not obstruct navigation even during low tide, when the water retains a depth of 26 ft. over the bar. The river from source to outlet extends little more than 300 mi. in a straight line, but because of the sinuous course, the actual length is about 700 mi. The flood period of the Gambia is from June to November, at which time the Barraconda rapids, some 275 mi. from the mouth of the river, are traversable by small craft. The Gambia R. was for long the only important artery of trade in The Gambia. It was discovered by the Portuguese about 1446 and was explored in 1455 by the Venetian navigator Alvise da Ca Da Mosto (1432?–1511?).

GAMBIER ISLANDS. See POLYNESIA, FRENCH.

GAMBLING or **GAMING**, wagering of money or other consideration of value on an uncertain event which is dependent either wholly on chance, as in roulette (q.v.), or partly on chance

and partly on skill, as in certain card games and in sporting contests. Gambling has been practiced by the peoples of the world throughout history. Anthropologists, who have found evidence of games of chance among the most primitive peoples, contend that the attitude of primitive man toward gambling derived from his general attitude toward his environment. To him the world was a mysterious place controlled by gods or supernatural beings whose favor or disfavor was manifested through chance situations and through the outcome of such events as hunts, wars, and games of chance; instruments of divination frequently included objects used in gambling.

As man gradually acquired knowledge of the nature of his environment and interpreted it in terms of cause and effect, his attitude toward gambling changed. Games of chance became pastimes, but the ancient belief that a lucky gambler was favored of the gods persisted and still survives in various forms. Among the upper classes of the peoples of antiquity, gambling was frequently associated with profligacy and licentiousness. During the Middle Ages, in times of trouble, the rabbis in European Jewish communities banned dice games and other games of chance. Gambling was also proscribed by some oriental religions, such as Confucianism, by the Koran of Islam, and by the moral codes of many Protestant denominations.

In modern times gambling occurs in practically all nations and takes a great variety of forms. Among the most widespread are betting on the outcome of horse and dog races (see HORSE RACING, FLAT); of bull, cock, and prize fights; of wrestling matches; and of such games as baseball, football, basketball, and hockey. Attempts on the part of professional gamblers to fix the outcome of such games have caused numerous scandals and provoked many representatives of organized sports to oppose professionally arranged betting on such events. Other common forms of gambling include roulette, card and dice games, and bingo. Games of this type, as well as slot machines, constitute a major industry in the State of Nevada, where gambling was legalized in 1931. Similar games also are played at the most famous of all European gaming resorts, the casino of Monte Carlo, which provides the principality of Monaco with a substantial part of its revenue. A form of gambling dating back to ancient times is the lottery (q.v.), which is often used as a money-raising technique by governments and by religious and charitable organizations.

In general, the attitudes of governments

GAMBOGE

toward gambling have been that the practice should be discouraged or regulated. To this end, the British Parliament in 1845 passed an act providing "that all contracts or agreements, by way of gaming or wagering, shall be null and void, and that no suit shall be brought in any court of law for recovering money alleged to have been won upon a wager". Similar legislation has been enacted in all the States of the United States; some States have considerably more restrictive laws against gambling and betting, particularly if professionally organized. One form of public betting that is acceptable in many States is the pari-mutuel system, which is often employed for horse and dog races and for jai alai games. Pari-mutuel betting, which originated in France in the 1860's, provides for a pooling of monies wagered on a given race; after track expenses and taxes are deducted, the remaining sum is apportioned among the winning bettors. The pari-mutuel system serves as protection against dishonesty and facilitates collection of gambling taxes. In order to raise additional revenue, New York City on April 7, 1971, opened the first legalized off-track betting system (O.T.B.) in the United States, enabling the public to place horseracing bets at special locations throughout the city.

See also HORSE RACING, FLAT: *Betting*.

At the present time one of the more permissive countries in regard to gambling is Great Britain. Under laws enacted there in 1960 and 1963, betting offices for making wagers on races and games have been licensed; games of chance are allowed in private clubs and homes; and mechanical gambling devices such as slot machines are legal, provided that the odds are not weighted too heavily in favor of the concessionaire, who is permitted only expenses and a "fair" recompense.

Because a great part of gambling is illegal, statistics on the number of persons who gamble and on the amounts of money involved in gambling transactions are unobtainable; however, it is estimated that in the U.S. alone about \$50,000,000,000 is spent on gambling pastimes in a single year.

GAMBOGE, gum resin obtained from the bark of various Asian trees of the genus *Garcinia*, or from American trees of the genus *Vismia*. Gamboge is orange-red in the resin form and becomes bright yellow when powdered. The best-quality gamboge, obtained from the island of Singapore and from the area surrounding Canton, China, is a product of *G. hanburyi*, a tree native to S.E. Asia; the word "gamboge" is derived from the name Cambodia. American gam-

boge, which is similar to the Oriental form, is obtained from the tropical tree *V. guianensis* and related species. Gamboge is used as a yellow pigment by artists, as a resin in varnishes, and, in medicine, as a cathartic and diuretic. It occurs in commerce in three forms: rolls (solid cylinders), pipes (hollow cylinders), and amorphous cakes. The first two kinds are purer than the third.

GAME AND GAME LAWS, terms applied to the various animals hunted by sportsmen and to the laws regulating such hunting. Within the meaning of the Federal and State game laws, as construed in the courts of the United States, game is generally held to mean animals fit for food, including fish, beasts, and birds; under some statutes the term is also held to include animals valuable for their fur (q.v.). Oysters and clams that have been planted in beds by commercial fishermen generally are not considered to be game, but to be the private property of the fishermen.

It is well established that the Federal or State governments, acting under their police power, may make regulations for the preservation of game or fish, restricting their taking and molestation to certain periods of the year, or prohibiting the hunting and killing of game entirely. Apart from the police power of the State, the ownership of fish and game resides in the people of the State. Where no individual has any property rights to be affected, the legislature, as the representative of the people, may withhold or grant to individuals the right to hunt and kill game, or may qualify or restrict that right. In other words, to hunt and kill game is a privilege either expressly granted or implied by sovereign authority, rather than an individual right. For a discussion of hunting and fishing in Federal wildlife refuges, see CONSERVATION.

Each of the fifty States has its own game laws, which are administered by fish and game commissions or by other agencies. These laws differ widely in some respects. Under most statutes, the possession or sale of certain fish or game during certain seasons is prohibited. Occasionally these statutes expressly apply only to game caught within the State. Where the statutes do not specify the place where the game is caught, it has been ruled in some jurisdictions that the statutes apply only to game caught within the State. The contrary, however, has obtained in most States, where these statutes have been held to apply to out-of-season possession or sale of game whether or not it was caught within the State. Some statutes contain a prohibition against taking outside the State game

killed within the State. Many States require hunting licenses, for which a nominal fee is charged. Such licenses permit the hunting of certain varieties of game during stipulated periods. In many States the game laws also impose restrictions of a similar nature on fishing. Where waters lie between two States the right of fishery is generally regulated by an agreement between the two States.

When lands or waters are owned by a private individual, the exclusive right of hunting or fishing thereon belongs to the owner or his tenant. If the owner has land on both sides of a stream, he has the exclusive right to fish in the stream, but if he has land on one side only, his right extends only to the center of the stream.

See also FISHING; HUNTING; WHALING: *Regulations*.

GAMELIN, Maurice Gustave (1872–1958), French army commander, educated at the Saint-Cyr Military School. In 1906 he became a member of the staff of the 6th infantry division of General Joseph Jacques Césaire Joffre (q.v.). During World War I Gamelin served for a time as major on the staff of Joffre and was eventually promoted to the rank of brigadier general. Following the war he spent six years with a military mission to Brazil, and in 1925 he was dispatched to Syria to quell the Druse rebellion (see DRUZES). He was named chief of the general staff in 1931 and in that capacity directed the extension of the Maginot Line; see FORTIFICATION AND SIEGE-

CRAFT. In 1935 he became inspector-general of the French Army and vice-president of the Higher Council of War, succeeding General Maxime Weygand (1867–1965). Three years later Gamelin was made chief of the general staff of national defense. By prearrangement with Great Britain, he was appointed commander in chief of the Allied forces on the invasion of Poland by Germany in September, 1939. On May 18, 1940, when the French armies were being routed by the Germans, he was replaced by Weygand. Later in that same year Gamelin was arrested by the pro-German Vichy government (see FRANCE: *History*) and charged with partial responsibility for the entry into the war and the resulting defeat of France. At the trials in the French town of Riom (q.v.) in 1942, Gamelin refused to testify in the proceedings implicating the French army. After the trials he was interned in northern Italy by the Germans. On being released and repatriated in 1945, he went into retirement.

GAME PRESERVE. See CONSERVATION: *Wildlife Conservation*; FISH AND WILDLIFE SERVICE.

GAMES, ANCIENT, exhibitions of athletic contests and other types of public spectacle which were a salient feature of the social and religious life of ancient Greece and Rome. In Greece the games served at first as an element in various religious observances; some were held in honor of the gods, some as offerings of thanksgiving, and others, in later times, in honor of living persons. The Greek games played an

A black-figured Athenian amphora, dating from the 6th century B.C., depicts a boxing match. The sport was an integral part of the Olympic Games of ancient Greece.

Metropolitan Museum of Art—
Rogers Fund



GAMES, THEORY OF

important role in developing the appreciation of physical beauty which is typical of Greek art and literature. Until a relatively late stage in Greek history, the participants in the games were drawn from among the citizens rather than from among professional athletes. As the games took on an increasingly professional character they rapidly declined in public esteem. The Greeks conducted four major cycles of games: the Olympic Games, the Pythian Games, the Isthmian Games (qq.v.), and the Nemean Games.

The Roman games, like those of the Greeks, were partly religious in nature. To assure the continued favor of the gods, the consuls of Rome were required at the beginning of each calendar year to hold games dedicated to the gods. Funds for these spectacles were at first supplied by the public treasury. Later, corrupt politicians used the games to win the favor of the populace, and vied with each other in the lavishness and extravagance of the games, which were held on the flimsiest of pretexts and eventually lost their original religious meaning and purpose. The Roman games differed radically from the Greek games in several essentials. Whereas in Greece the people were often participants, in Rome they were mere spectators, and only professionals, slaves, and prisoners customarily took part. Also, whereas the Greek games depended for their entertainment value chiefly on competition among athletes, the Roman games were often characterized by the staging of battles fought to the death and involving large numbers of human beings and beasts. See also FESTIVALS AND FEASTS: *Roman Festivals*; GLADIATOR; PENTATHLON.

GAMES, THEORY OF, branch of mathematics that is useful in social science, business, war strategy, and other areas involving conflict of interest, in which pure chance and selective strategies play determining roles. The study was founded in the early 1920's by the French mathematician Félix Édouard Émile Borel (1871-1956) and the American mathematician John von Neumann (q.v.); it received great impetus with the publication of *Theory of Games and Economic Behavior* (1944) by von Neumann and the German-born American economist Oskar Morgenstern (1902-77).

Two examples will illustrate the mathematical principles involved in theory of games. Players A and B alternate in throwing a die; immediately after his throw, the player chooses a positive integer equal to or less than the value of the throw. This integer is not known to his opponent but is given to a referee, who adds the

number to the sum of those given previously. The first person who makes the cumulative score exceed 21 is the loser and must pay a stipulated sum to the winner. The theory of games develops certain mathematical methods for determining the best strategy for each player.

A second example illustrates a game that does not involve the element of chance. Each of four cards contains three numbers, as follows: card I: 3, -5, 2; card II: -1, -1, 2; card III: 1, 5, -6; card IV: -3, 1, 2. Player A names a card, I, II, III, or IV, and makes his choice known to a referee. Without knowing A's choice, Player B specifies the first, second, or third number. It is agreed that if the specified number, n , on the named card is positive, A pays B n dollars, but if n is negative, B pays A $-n$ dollars. Again, the theory of games mathematically determines the best strategy for the players, answering such questions as what choice each player should make to realize the greatest profit and how the players should vary their choices if the game is repeated a number of times.

These are examples of so-called zero-sum games, in which one person's gain is another's loss. Not all games are zero-sum; in economic "games", goods may be created or destroyed so that the sum totals at the end differ from those at the beginning. Games with more than two players are more difficult to analyze mathematically, partly because of the possibilities for coalitions among players.

J.Si.

GAMETE, sexual reproductive cell that fuses with another sexual cell in the process of fertilization (q.v.). The cell resulting from the union of two gametes is called a zygote; the zygote usually undergoes a series of cell divisions while it develops into a mature animal or plant; see EMBRYOLOGY; REPRODUCTION.

Gametes vary widely in structure. The simplest sexual organisms are isogamous; that is, they produce a single kind of gamete. The identical gametes unite in pairs to produce zygotes. Although all isogametes are apparently alike in structure, they are thought to be different in physiological constitution, because gametes from the same individual or strain will not successfully unite. The simplest isogametes, those of lower fungi such as molds, are small cells that grow on the ends of body filaments and become detached when mature. Other lower organisms, such as lower algae, fungi, and protozoa (q.v.), have gametes formed by division of the protoplasm of single cells.

All higher plants are heterogamous; that is, they produce two kinds of gametes. The female gamete is called the egg (q.v.); the male gamete

is called the sperm. The organ of gamete production in plants is called a gametangium.

All animals that reproduce sexually, except a few protozoans, are also heterogamous. The male gametes are called spermatozoa; female gametes, the ovum or egg. The organs of gamete production in animals are called gonads (see REPRODUCTIVE SYSTEM: *Origin of the Reproductive Cells: Gonads*). The formation of gametes in the gonads of animals is called gametogenesis. By this process the number of chromosomes in the germ cells is reduced in number from diploid to haploid, which is half the number of chromosomes in the normal body cells of the species. The diploid number of human chromosomes, for example, is 46. When a human germ cell divides to form two gametes, each gamete receives only half, or 23, of the normal complement of chromosomes. This type of cell division is called meiosis. The normal total of chromosomes is restored in fertilization when two gametes fuse, each contributing half of the chromosomes required by the zygote. See HEREDITY: *Physical Basis of Heredity*.

GAMMA GLOBULIN, complex protein in plasma, the fluid portion of blood. It contains antibodies produced in the liver, spleen, bone marrow, and lymph glands to protect the body from invading viruses or bacteria, called antigens; see BACTERIA; VIRUS. Each disease antigen stimulates production of a specific antibody, which circulates in the blood for a period of time. When antibodies encounter an antigen identical to that which originally stimulated their production, they engulf and destroy it, thus conferring immunity (q.v.). Immunity is also conferred by vaccination (q.v.) with killed or weakened organisms, which likewise cause production of antibodies. Since the gamma globulin contains these antibodies, it is often taken from patients who have recovered from mumps, chicken pox, German measles, and hepatitis (qq.v.), and given to confer a rapid but short-term immunity on persons recently exposed to those diseases. Pooled gamma globulin, collected from a variety of donors and containing antibodies to most infectious organisms, is also used. People who suffer from an unusual deficiency of gamma globulin known as agammaglobulinemia are deficient in antibodies and may require periodic infusions of gamma globulin to maintain protection.

In 1969 scientists at Rockefeller University determined the chemical structure of gamma globulin. This discovery may help scientists to find ways to control the response of the body to foreign substances, including organ and tissue

transplants, the rejection of which causes transplant failure; see TRANSPLANT, MEDICAL.

GAMOW, George (1904–68), Russian-American theoretical physicist, born in Odessa (now Ukrainian S.S.R.), and educated at the University of Leningrad. His early work in nuclear physics was done at the universities of Leningrad, Göttingen, Copenhagen, and Cambridge. Gamow became professor of physics at Leningrad in 1931, but left the Soviet Union in 1933. The following year he moved to the United States, and he became naturalized in 1940. He was professor of theoretical physics at George Washington University (1934–56) and professor of physics at the University of Colorado (1956–68).

Gamow made important contributions in a wide variety of fields, including radioactivity and cosmogony as well as astrophysics and nuclear physics. He was one of the leading exponents of the theory of the evolutionary universe. See COSMOGONY. He wrote many books for the layman, including *The Birth and Death of the Sun* (1940), *One Two, Three . . . Infinity* (1947), and *Thirty Years that Shook Physics* (1965).

GANDER, airport and town of Canada, in Newfoundland, on the N. shore of Gander Lake, about 175 miles N.W. of Saint John's. The airport is a refueling, service, and transfer station on one of the busiest transoceanic air routes in the world. Construction of the airport was begun in 1937. With the outbreak of World War II, Gander was first used as an antisubmarine patrol base by the Royal Canadian Air Force and subsequently as an Atlantic ferry base for British, Canadian, and American aircraft. In 1945 the base became a civilian airport, which the Canadian government acquired in 1949. After that the runways and facilities were expanded, making it possible for the airport to service long-range jet aircraft. Pop. (1971) 7748.

GANDHI, Indira Nehru (1917–), prime minister of India (1966–77) whose strong leadership was ended by opposition to the state of emergency in effect from 1975 to 1977.

On Nov. 19, 1917, in Allahabad, India, Indira Priyadarshini Nehru was born into the center of Indian political life, the only child of Jawaharlal Nehru (q.v.), later the first prime minister of India. A graduate of Visva-Bharati University, Bengal, she also studied at Oxford University. In 1938 she joined the National Congress Party and became actively involved in India's movement for independence from Great Britain. In 1942 she married Feroze Gandhi (d. 1960), a Parsee lawyer who also was active in the Congress Party. Shortly after their marriage, both were arrested by British authorities on charges of



Indira Gandhi, prime minister of India, inspects a guard of honor in August, 1967, during the country's 20th celebration of its liberation from British rule. The ceremony took place at historic Red Fort, in New Delhi, the Indian capital. Mrs. Gandhi, only child of India's first prime minister, Jawaharlal Nehru, is her country's third prime minister, and has held the office since 1966. UPI

subversion. During their thirteen months of imprisonment, Mrs. Gandhi taught prisoners to read and write.

When India won its independence in 1947 and Nehru took office as prime minister, Indira Gandhi became his official hostess. (Her mother had died in 1936.) She also served as his confidante on national problems, sometimes acting as critic and influencing his policies. She accompanied her father on many trips to foreign countries.

In 1955 she was elected a member of the executive body of the Congress Party and established herself as a national political figure in her own right. Four years later came her election as president of the party, a post she held for one year. Subsequently, she continued to campaign for the party and devoted her attention to social-welfare programs. In 1962, during the Chinese-Indian border war, she was chairman of the Citizens' Central Council and coordinated civil defense activities. In 1964 she was elected to the United Nations Educational, Scientific, and Cultural Organization (q.v.).

Following the death of her father in May, 1964, Mrs. Gandhi became minister of information and broadcasting (although she might have been foreign minister), under Lal Bahadur Shastri (1904-66), her father's successor. In this post she extended broadcasting time, liberalized censorship policies, and approved a television education project in family planning. When Shastri died suddenly, Mrs. Gandhi succeeded him as prime minister, taking office Jan. 24, 1966. In 1967 she was elected to a five-year term by the parliament members of the dominant

Congress Party. In 1971 she led her party to a landslide victory in national elections.

In 1975 Mrs. Gandhi was convicted of violating election laws during the 1971 campaign. Maintaining innocence, she charged the conviction was part of an attempt to remove her from office, which, she said, threatened internal security. At her behest a national state of emergency was declared on June 26. Although her conviction was overturned later in the year by the Indian Supreme Court, the emergency was continued. Mrs. Gandhi placed many aspects of life in India under her strict control, and thousands of dissenters were imprisoned. She relied increasingly on the assistance of her son, Sanjay Gandhi (1946-), a political neophyte. Hoping to demonstrate popular support for her regime, which critics contended was undermining India's democratic system, Mrs. Gandhi called a general election in March, 1977. In the voting she lost her seat in parliament, and the Congress Party was badly defeated by the Janata Party, a coalition formed to oppose her rule.

GANDHI, Mohandas Karamchand, known as MAHATMA GANDHI (1869-1948), Indian nationalist leader, born in Porbandar, Western India States (now Gujarat State), and educated in law at University College, London. In 1891, after having been admitted to the British bar, Gandhi returned to India and attempted to establish a law practice in Bombay, with little success. Two years later an Indian firm with interests in South Africa retained him as legal adviser in their office in Durban. Arriving in Durban, Gandhi found himself treated as a member of an inferior race, and was appalled at the wide-

spread denial of civil liberties and political rights to Indian immigrants to South Africa. He threw himself into the struggle for elementary rights for Indians.

Passive Resistance. Gandhi remained in South Africa for twenty years, suffering imprisonment many times. In 1896, after being attacked and beaten by Caucasian South Africans, Gandhi began to teach a policy of passive resistance to, and noncooperation with, the South African authorities. Part of the inspiration for this policy came from the Russian writer Count Lev Nikolaevich Tolstoi (q.v.), whose influence on Gandhi was profound. Gandhi also acknowledged his debt to the teachings of Christ as expressed in "whosoever shall smite thee on thy right cheek, turn to him the other also" (Matt. 5:39), and to the 19th-century American writer Henry David Thoreau (q.v.), especially to Thoreau's famous essay "Civil Disobedience." Gandhi considered the names "passive resistance" and

"civil disobedience" inadequate for his purposes, however, and coined the word *Satyagraha* (Skr. "truth and firmness"). During the South African War (q.v.), also known as the Boer War, Gandhi organized an ambulance corps for the British Army and commanded a Red Cross unit. After the war he returned to his campaign for Indian rights. In 1910, he founded Tolstoi Farm, near Durban, a cooperative colony for Indians. In 1914, the government of the Union of South Africa made important concessions to the demands made by Gandhi and the Indians, including recognition of Indian marriages and abolition of the poll tax for Indians. Gandhi, judging his work in South Africa done, returned to India.

Campaign for Home Rule. He became a leader in a complex struggle, the Indian campaign for home rule. Following World War I, in which he played an active part in recruiting campaigns, Gandhi, again advocating *Satyag-*

Mahatma Gandhi in 1938, shown during a tour of jails in Calcutta, where he interviewed political prisoners with a view to negotiating their release.
UPI



raha, launched his movement of passive resistance to Great Britain. When, in 1919, Parliament passed the Rowlatt Act, giving the Indian colonial authorities emergency powers to deal with so-called revolutionary activities, *Satyagraha* spread through India, gaining millions of followers. A demonstration against the Rowlatt Act resulted in a massacre of Indians at Amritsar by British soldiers; in 1920, when the British government failed to make amends, Gandhi proclaimed an organized campaign of noncooperation. Indians in public office resigned, government agencies such as courts of law were boycotted, and Indian children were withdrawn from government schools. Throughout the country, streets were blocked by squatting Indians who refused to rise even when beaten by colonial police. Gandhi was arrested, but the British were soon forced to release him.

Economic independence for India, involving the complete boycott of British goods, was made a corollary of Gandhi's *Swaraj* (Skr. "self-ruling") movement. The economic aspects of the movement were significant, for the exploitation of Indian villagers by British industrialists had resulted in extreme poverty in the country and the virtual destruction of Indian home industries. As a remedy for such poverty, Gandhi advocated resuscitation of cottage industries; he began to use a spinning wheel as a token of the return to the simple village life he preached, and of the revival of native Indian industries.

The Indian leader became the international symbol of a free India. He lived a spiritual and ascetic life of prayer, fasting, and meditation. His union with his wife became, as he himself stated, that of brother and sister. Refusing earthly possessions, he wore the loincloth and shawl of the lowliest Indian and subsisted on vegetables, fruit juices, and goat's milk. Indians revered him as a saint and began to call him *Mahatma* (Skr., "great-souled"), a title reserved for the greatest sages. Gandhi's advocacy of nonviolence, known as *ahimsa* (Skr., "noninjury"), was the expression of a way of life implicit in the Hindu religion. By the Indian practice of nonviolence, Gandhi held, Great Britain too would eventually consider violence useless, and would leave India.

The Mahatma's political and spiritual hold upon India was so great that the British authorities dared not interfere with him. In 1921 the Indian National Congress, the group that spearheaded the movement for nationhood, gave Gandhi complete executive authority, with the right of naming his own successor. The Indian population, however, could not fully compre-

hend the unworldly *ahimsa*. A series of armed revolts against Great Britain broke out, culminating in such violence that Gandhi confessed the failure of the civil-disobedience campaign he had called, and ended it. The British government again seized and imprisoned him in 1922.

After his release from prison in 1924, Gandhi withdrew from active politics and devoted himself to propagating communal unity. Unavoidably, however, he was again drawn into the vortex of the struggle for independence. In 1930 the Mahatma proclaimed a new campaign of civil disobedience, calling upon the Indian population to refuse to pay taxes, particularly the tax on salt. The campaign was climaxed by a march to the sea, in which thousands of Indians followed Gandhi from Ahmadabad to the Arabian Sea, where they made salt by evaporating sea water. Once more the Indian leader was arrested, but he was released in 1931, halting the campaign after the British made concessions to his demands. In the same year Gandhi represented the Indian National Congress at a conference in London.

Attack upon the Caste System. In 1932, Gandhi began new civil-disobedience campaigns against the British. The Mahatma was arrested twice and he fasted for long periods several times; these fasts were effective measures against the British, because revolution might well have broken out in India if he had died. In September, 1932, while in jail, Gandhi undertook a "fast unto death" to improve the status of the Hindu Untouchables; see CASTE. The British, by permitting the Untouchables to be considered as a separate part of the Indian electorate, were, according to Gandhi, countenancing an injustice. Though he was himself a member of the Vaisya (merchant) caste, Gandhi was the great leader of the movement in India dedicated to eradicating the unjust social and economic aspects of the caste system.

In 1934 Gandhi formally resigned from politics, being replaced as leader of the Congress Party by Shri Jawaharlal Nehru (q.v.). Gandhi traveled through India, teaching *ahimsa* and eradication of "untouchability". The esteem in which he was held was the measure of his political power. So great was this power that the limited home rule granted by the British in 1935 could not be implemented until Gandhi approved it. At length, in 1939, he again returned to active political life because of the pending federation of Indian principalities with the rest of India. His first act was a fast, designed to force the ruler of the State of Rajkot to modify his autocratic rule. Public unrest caused by the

fast was so great that the colonial government intervened; the demands were granted. The Mahatma again became the most important political figure in India.

Independence. When World War II broke out, the Congress Party and Gandhi demanded a declaration of war aims and their application to India. The response from the British was unsatisfactory, and the Party decided not to support Britain in the war unless the country were granted complete and immediate independence. The British refused, offering compromise proposals which were rejected. When Japan entered the war, Gandhi still refused to agree to Indian participation. He was interned in 1942 but was released two years later because of failing health.

By 1944 the Indian struggle for independence was in its final stages, the British government having agreed to independence on condition that the two contending nationalist groups, the Muslim League and the Congress Party, should resolve their differences. Gandhi stood steadfastly against the partition of India but had ultimately to agree, in the hope that there would be internal peace after the Muslim demand for separation had been satisfied. India and Pakistan became separate states when the British granted India its independence in 1947. During the riots which followed the partition of India, Gandhi pleaded with Hindus and Muslims to live together peacefully. Riots engulfed Calcutta, one of the largest cities in India, and the Mahatma fasted until disturbances ceased. On Jan. 13, 1948, he undertook another successful fast in New Delhi to bring about peace, but on Jan. 30, twelve days after the termination of that fast, he was assassinated by a fanatic Hindu.

The death of Gandhi was regarded as an international catastrophe, for his place in humanity was measured not in terms of the 20th century but of all time. A period of mourning was set aside in the United Nations General Assembly, and condolences to India were expressed by all countries. Religious violence soon waned in India and Pakistan, and the teachings of Gandhi came to inspire nonviolent movements elsewhere, notably in the United States under the civil-rights leader Martin Luther King, Jr. (q.v.).

GANGES (Hind. *Ganga*), major river of the Indian subcontinent, formed on the s. ranges of the Himalaya, in N. Uttar Pradesh State, Republic of India. Except for extensive streams of the eastern delta in Bangladesh, all of the river is in the Republic of India. The Ganges basin, one of the most fertile regions of the world and also one of the most densely populated, lies be-



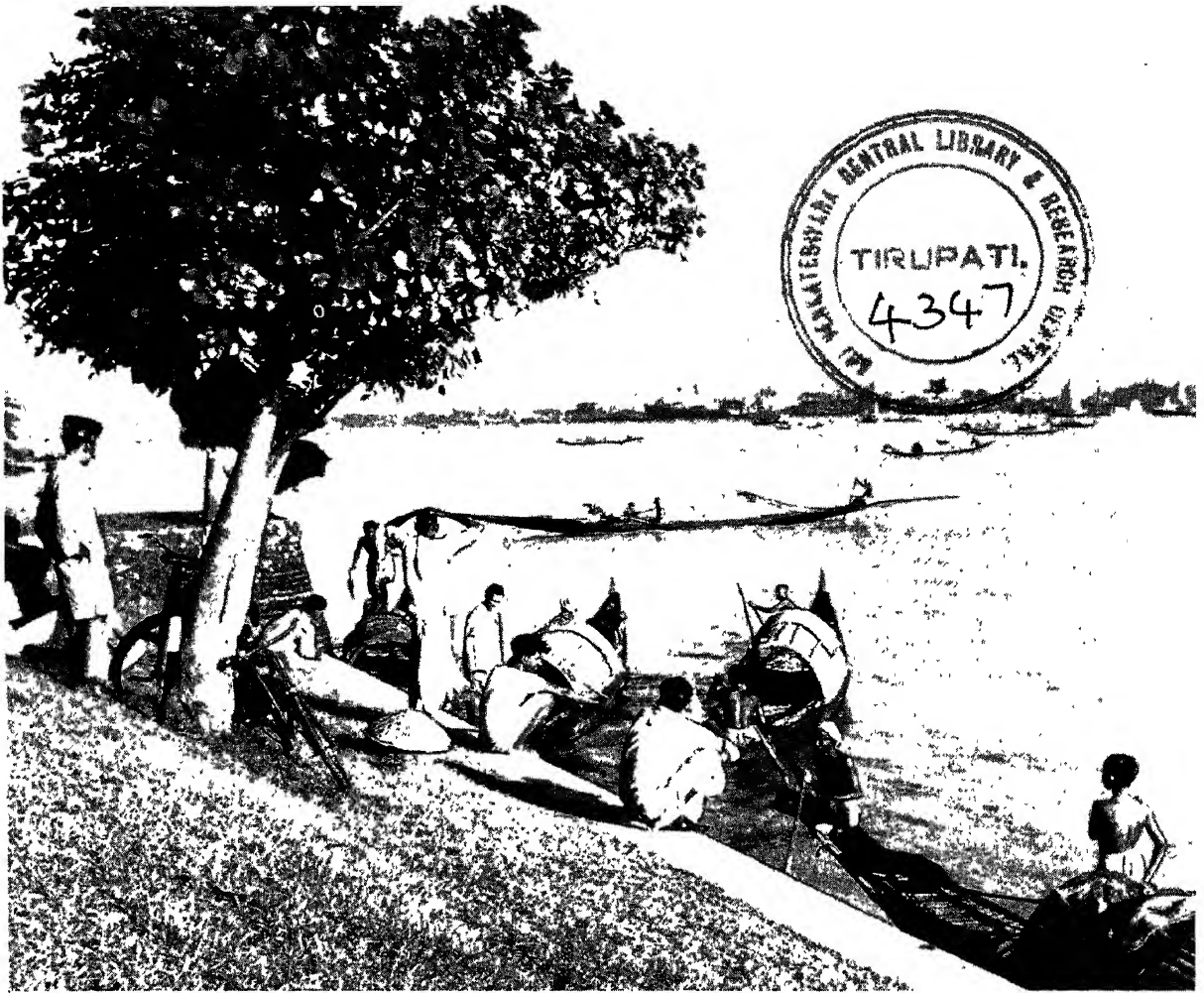
The Ganges River and its tributaries.

tween the Himalaya and the Vindhya Hills, and embraces an area of more than 390,000 sq.mi.

The river, about 1540 mi. long, rises in a snowfield situated among three Himalayan mountains all more than 22,000 ft. high. It issues as the Bhagirathi R. from an ice cave, 10,300 ft. above sea level, and falls 350 ft. a mile. About 10 mi. from the source is Gangotri, the first temple on its banks and a traditional resort of pilgrims. At the village of Devaprayag, 133 mi. from the source, the Bhagirathi joins the Alaknanda; the united streams are called the Ganges.

The Ganges, after descending 9276 ft., or an average of nearly 60 ft. per mi., flows w. to the border of the great plain of Hindustan at Hardwar, 157 mi. from its source and 1024 ft. above sea level. From Hardwar it continues s. and then s.e. to Allahabad after a winding course of 488 mi., made unnavigable by shoals and rapids.

At Allahabad, the Ganges is joined by the Jumna R. from the s.w., and from that point the river flows e. past Mirzapur, Varanasi, Ghazipur, Patna, Monghyr, and Bhagalpur, receiving on the s. the Son R. and on the n. the Gumti, Ghaghara, Gandak, and Kosi rivers. In the Rajmahal Hills, at the head of the Ganges delta, 563 mi. from Allahabad, the river turns southward and begins a descent of 283 mi. to the Bay of Bengal (see BENGAL, BAY OF). Near Pakaur, the Bhagirathi (assuming the former name of the river) and, 71 mi. lower down, the Jalangi R. branch off from the main stream, and after individual courses of 120 mi. each, unite to form the Hooghly River (q.v.), the westernmost and principal channel of navigation, on which the city of Calcutta stands. The main branch of the Ganges, from which numerous minor tributaries flow, continues in Bangladesh as the Padma R. to the town of Sibalay,



Fishermen pole their small boats from the banks of the Ganges R. in Calcutta to the fishing grounds a few miles offshore in the Bay of Bengal. United Nations

where it unites with the Jamuna, the main branch of the Brahmaputra (q.v.), and finally runs through the wide estuary of the Meghna into the Bay of Bengal.

Between the Meghna estuary and the w. channel of the Hooghly R. are the several mouths of the deltaic channels. The n. portion of the delta is fertile and well cultivated. The s. section consists mostly of swampland, known as the Sundarbans, because of the sundari tree which flourishes there. The marshes are infested by several species of crocodile (q.v.). From year to year the Ganges exchanges old channels for new ones, particularly in the alluvial basin of its lower reaches.

The Ganges is regarded by Hindus as the most sacred river in the world; see HINDUISM. Many important religious ceremonies are held in a number of cities along its banks, including Varanasi, Hardwar, and Allahabad.

GANGRENE, mass death or necrosis of individual cells or tissues of a living organism. Gan-

grene is tissue death, as distinguished from somatic death, the death of the organism as a whole; see DEATH. The dead mass, or sphacelus, may include bone as well as soft tissue. The immediate physiological cause of gangrene is blockage of arterial blood supply. Precipitating causes of gangrene may be frostbite (q.v.), burns, prolonged pressure, and blows or wounds. The location and size of the occluded blood vessels can affect the extent of gangrenous damage. Occlusion of one of the larger arteries of the body can lead to massive necrosis of tissues; blocking of small vessels near the body surface may result only in gangrene of a part of the skin area.

Among symptoms of gangrene are loss of sensation and function. The affected part becomes cold, turns progressively darker in color, and finally undergoes decomposition. Dry or chronic gangrene, as in arteriosclerosis, occurs when the arteries are blocked gradually and the tissues are bloodless. Wet or acute gangrene, as in diabetes, occurs when the arteries are blocked suddenly and the tissues are blood-filled. See GAS GANGRENE.

